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Apple Mac mini M4

Turns out that Apple has kept busy over the past three years as it's kept us waiting for a new Mac mini. This M4 update is spectacular on every level, whether through its power – Apple's M4 and M4 Pro silicon is a great choice for such a compact system – or through its slashed-down size. There are some who will rightly point out that all Apple has done is catch up with mini PCs that run Windows (we can't get overly excited about front-mounted USB-C ports), but if you're after a quiet, mini computer that packs an over-sized punch, then turn to p44.

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We always like to find (and test!) a diverse collection of festive treats for the inner geek within us all, and this year we serve up a selection of 36 from £4.50 to £3,499.

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Ignoring AI is like leaving the VCR to your kids

I was brilliant at maths as a child. I loved it, running to lessons with my tie-up mittens swinging in the wind. Same at secondary school, where I romped through my exams with glee. I even enjoyed it at sixth form college, but should have taken the hint when I found that Further Maths was trickier than I had expected. Unfortunately I ignored that clue, instead deciding to study Maths at university. And then, for precisely three years, I hated it.

Now, this fascinating romp through my childhood is my way of saying that we all hit a barrier. And it happens with technology, too. Some people refused to switch to mobile phones. Some despise the Ribbon in Microsoft Office and stick with software that's two decades old. And, most famously, many parents were so distraught by their VCR's controls that they delegated all responsibility to their kids.

We're going through another phase change in technology, and I have this message for all the AI doubters: you are now the parents flinging the VCR remote across the room. It's easy to bash AI, to laugh at six-fingered men created by early versions of Midjourney or the farcical hallucinations of ChatGPT. But return to those tools now – remembering we're only two years on from the moment that OpenAI released its engine for public view – and you'll see that AI has grown up. People have the correct number of appendages. Chatbots add references so you can confirm the answers. The difference between late 2022 and late 2024 is exponential improvement in action.

There are reasons to be dubious. Even we technology lovers prefer to have a vague grip on what's going on, but AI is essentially a black box that would appear magical to someone even 20 years ago. And there is a threat to livelihoods, whether you work as an IT admin, sit in middle management or, as a random example, edit a magazine. But it has always been thus. I have no idea what your job is, or was, but I'll place a safe bet that it didn't exist a century ago.

There are reasons to be optimistic, too. "Previous industrial revolutions were at the scale of strength and might," Michael Conway, IBM Consulting's UK & Ireland AI lead told me in an interview. "It would be trite to say that each person is ten times more powerful [through AI assistance], but they will be '*n*' times more knowledgeable." So if we embrace AI, he argues, we will complete tasks more quickly and to a higher quality. We're already seeing this on a basic level with Teams taking notes and action points from meetings. That's only the start.

Where might it end? I also interviewed Patrick Willer, a "tech philosopher" who founded a consultancy called Innovation Network. He told me that "literally within ten years, I don't think anybody has to work any more". That those who wanted to work will be able to, of course, but it will be voluntary because so much work would be done by AI.

I'm not saying I subscribe to that view, whether you consider it optimistic or dystopian, but I have zero doubt that the way we work is going to change. But whereas we had 50 years of gentle revolution with computers in the workplace, this time the transformation will be compressed into a decade.

Some people will want to cling to how things were. They will decry AI as hype. But this industrial revolution is on its way, and while it was okay to let the kids take over the VCR, if you do the same with AI then you'll effectively be handing in your resignation. In which case, you'd better hope that Patrick is right.

Tim Danton
Editor-in-chief

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Stuart Andrews
If there's one conclusion to draw from Stuart's test of 15 tablets, it's that the days when a tablet was purely for watching videos and browsing websites are long gone. See p76.

Rois Ni Thuama
It turns out that Rois' mum is the person to listen to when it comes to emerging tech threats, revealing to her daughter that 2025 will be all about supply chain management. See p116.

Lee Grant
Never mind the image of him as a mermaid, or the fact that he's now earned Copilot+ PC commercial accreditation: it's all about the prize giveaway on p115.

Barry Collins
The self-declared *PC Pro* everyman explains why he won't be upgrading his M1 MacBook Pro to the latest M4 edition (see p50). Find out why on p22.

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Inspired by Jon's One Last Thing column this month (*see p130*), we asked our contributors: aside from your smartphone, what is your most prized and useful piece of kit?

"I owe Douglas Engelbart huge thanks for inventing the mouse, because that's the item I'm never without. My current one is a basic Logi M750 and it's the perfect size whether on my desk or away from home."

"I'm not allowed to say 'my smartphone', but I wouldn't have said that anyway because my Asus Chromebook does everything a smartphone does, on a real keyboard and proper screen, sitting on the sofa."

"Call me boring, but the answer might be my personal NAS. There's simply no other resource like it in the world – a unique, enormous, robust archive of data created or collected by me, which I can browse, access and even share from anywhere."

"Podcast listeners will know that I have to pick a keyboard (of sorts), so I'm going for my Stream Deck, which is unspeakably useful for a memory-fuzzed klutz like me who can't remember keyboard shortcuts."

"My Apple Pencil as it's the starting point for almost all of my artwork, usually in combination with Affinity Designer."

"My HP12C financial calculator. Reverse Polish Notation entry system, chiclet keys and almost eternal battery life keep this on my desk. The other day I realised I'd been given it about 1983. That's 41 years ago."

"The washing machine and tumble dryer. Take my phone, laptop or connectivity and I'll be fine. Take my ability to conveniently launder the Grants' unending piles of washing, then I will come for you..."

"My PSVR2. It's more than an immersive games console. It's a decompression chamber with a cardio programme. No more lounging about in your shoot 'em ups. Get on your feet, get moving and start shootin'. Yee haw."

"The dual-motor rise and recline armchair with electric and independently adjustable footrest, backrest, lumbar and headrest that allows me to continue working with a disability. And the electric rising desk for the same reason."

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Briefing

Background and analysis on all the important news stories

Microsoft makes funeral plans for Windows 10

Extended support tariff and nag screens are ready for the October deadline

Microsoft is busy making preparations for when Windows 10 reaches end of support in October 2025, including an option for consumers to keep paying for support for the first time.

Windows 10 is by far the most used version of Windows in the world, with six in ten active Windows installations still running the OS, according to October 2024 data from Statcounter. That presents Microsoft with a huge problem, with it looking increasingly likely that Windows 10 will still have a greater installed base than Windows 11 by the time it's officially retired.

Extended support

The danger of leaving millions of Windows PCs without critical security updates is one that Microsoft has faced down in the past by continuing to provide post-deadline patches. Although extended support officially ended for Windows XP in April 2014, the company made three further emergency security patches to the OS in 2014, 2017 and 2019.

Likewise, even though extended support for Windows 7 came to an end in January 2020, the firm announced an Extended Security Updates programme for businesses that would provide an additional three years of security patches, albeit for a significant fee.

This time, Microsoft is inviting both consumers and businesses to take out Extended Security Updates (ESU) if they're not able or willing to part with their Windows 10 machines by the 14 October deadline.

"For the first time ever, we're introducing an ESU program for personal use as well," said Microsoft vice president Yusuf Mehdi. "The ESU program for consumers will be a one-year option available for $30. Program enrolment will be available closer to the end of support in 2025."

> "Windows 10 will still have a greater installed base than Windows 11 by the time it's officially retired"

Business will have their own ESU, with prices starting at $61 per device for the first year, doubling each year thereafter. The business scheme will run for three years, rather than the single year of the consumer version. But businesses that decide to join in year two must also pay the year one fee, as ESUs are cumulative.

ABOVE Windows 10's demise is less than a year away

What if users don't buy?

The question hanging over the scheme is what will happen if a sizeable number of consumers and businesses decide they won't pay the $30 or more that Microsoft wants for extended support. Will the company be forced to issue free critical patches for major vulnerabilities, as it has in the past?

Some security experts believe Microsoft is forcing businesses to make unenviable choices. "While this is a strategy for Microsoft to encourage the transition to newer operating systems, it places users and businesses in a balancing act between security and cost," said James McQuiggan of security firm KnowBe4.

He added: "For individuals and smaller organisations with limited budgets, the additional costs may discourage continued support, potentially pushing them to continue with vulnerable systems and exposing them to security risks. Upgrading hardware presents a difficult challenge for industries with legacy systems, like manufacturing or healthcare."

Others argue it's too risky for either consumers or businesses to leave that to chance. "Putting off upgrading to the latest operating system can put

you in a very vulnerable position as you will effectively raise a red flag to threat actors who could potentially attack your device remotely," said Jake Moore, cybersecurity advisor at ESET.

"It is always safest to use the latest, most up-to-date operating system as it will come packed with the latest security patches which keep threats at bay. Those sitting on the fence should consider the potential cost of losing their sensitive or financial data which is targeted by criminals."

He believes some will be forced to buy extended support because they're relying on software or hardware that's incompatible with Windows 11. "Extended support is likely to be expensive in an attempt to encourage users to upgrade to the latest version," Moore said. "But it will possibly come down to the amount of machines that require a certain version of Windows which are currently compatible with bespoke software and could cost more to upgrade those locally."

Nag screens are back

Microsoft will use another familiar tactic to try and convince the Windows 10 laggards to upgrade their PCs: nag screens.

> "If history is anything to go by, users can expect the nag screens to grow more aggressive as time passes"

In September, Microsoft issued update KB5001716 to all versions of Windows 10 and a very early version of Windows 11. According to the firm: "After this update is installed, Windows may periodically display a notification informing you of problems that may prevent Windows Update from keeping your device up-to-date and protected against current threats.

"You may see a notification informing you that your device is currently running a version of Windows that has reached the end of its support lifecycle, or that your device does not meet the minimum hardware requirements for the currently installed version of Windows."

If past history is anything to go by, users can expect the nag screens to grow more aggressive as time passes. With Windows 7, the end-of-support warnings started with notifications in spring 2019, almost a year before the OS reached the end of extended support.

They were followed by unavoidable full-screen alerts shortly after the support date had passed, warning users they were putting their security at risk by continuing to use an unsupported OS. The only way to disable the warnings was by deleting Registry keys.

Even now, millions of PCs operate on Windows 7, with Statcounter reporting the ancient OS still accounts for 2.6% of all Windows installations.

Apple still making life hard for rival browsers

EU browser engine choice not working, says rival

Apple's continued belligerence means not a single browser maker has taken advantage of the option to use their own browser engine for iOS in the EU, the CEO of Vivaldi told *PC Pro*.

The EU's Digital Markets Act in effect forced Apple to stop mandating that rival browsers use its own WebKit engine. Yet even competitors as large as Google have so far refrained from using their own browser engine in the EU, because Apple is putting too many obstacles in their path, according to Vivaldi founder Jon von Tetzchner.

He said that Apple was "gradually making it slightly easier" for browsers to use their own engines, but that it still wasn't feasible for his company to do so, not least because Apple still mandates WebKit in non-EU countries.

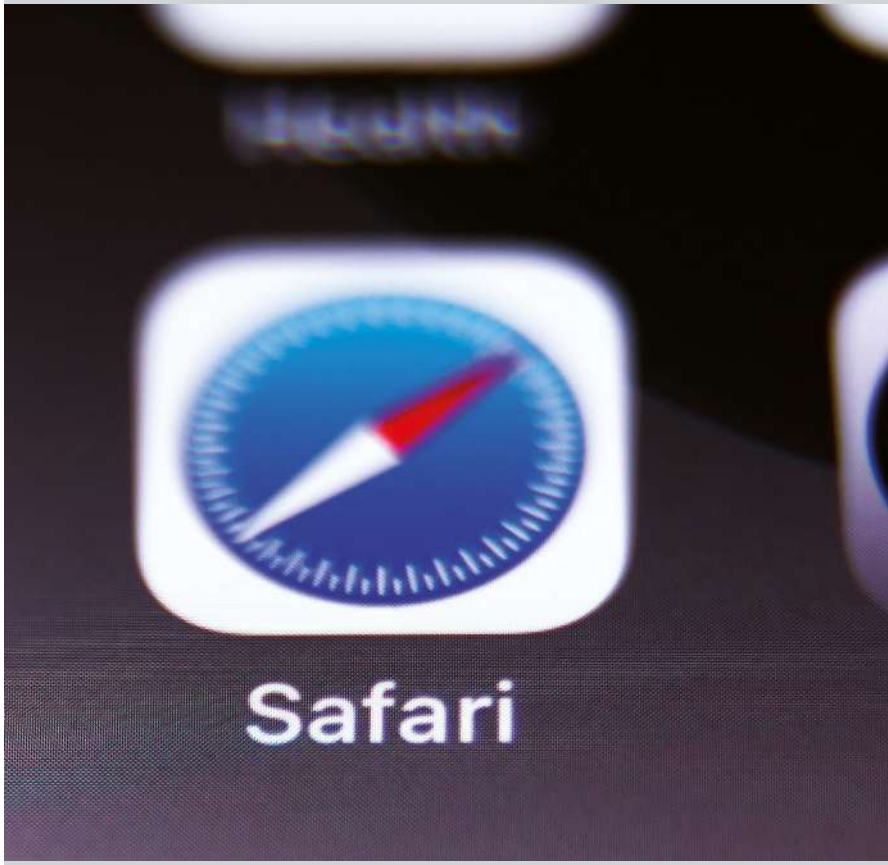
"They [Apple] want us to jump through a lot of hoops," said von Tetzchner. "After jumping through all those hoops, we'd have to deliver two different browsers, one of them outside the EU and one of them in the EU. As long as that's the case, it's twice the amount of work, and that's not feasible for us to do at this time."

The Vivaldi chief cites other restrictions that Apple has previously imposed on browser makers using their own engine, such as barring access to the browser for developers outside of the EU (now lifted) and onerous rules that – if breached – could see all of a company's apps removed from the App Store, not just the offending app.

"You have a situation where you know you're not wanted, they don't want you to deliver that browser, and they will try to put hindrances in place that makes it hard for you," said von Tetzchner.

"When you're a small company, all of those things add to the cost of doing things. And it's not like Google or Mozilla or any of these other guys with more resources than us have delivered either. We're all in the same boat on this one."

Apple didn't reply to *PC Pro*'s request for comment.



BELOW Apple's WebKit is still the only browser engine that's being used on iOS in the EU

Mobile merger turnaround

Why has the UK's competition watchdog as good as rubber-stamped the Vodafone/Three merger, despite huge concerns? Barry Collins investigates

You are the competition regulator. Your own lengthy investigation has found that a merger would increase prices for consumers by up to 20%, reduce competition in the market as a whole, and likely not deliver the promised network improvements suggested by the two merging parties. Do you (a) block the merger, or (b) give it your conditional blessing?

If you're the UK's Competitions and Market Authority (CMA), it seems the answer is (b).

Just months after finding that the merger of Vodafone and Three would likely do significant harm to consumers and the mobile market in general, the man in charge of leading the CMA's investigation, Stuart McIntosh, said he believed "this deal has the potential to be pro-competitive for the UK mobile sector if our concerns are addressed".

The CMA's findings

The CMA issued its provisional findings on the Vodafone/Three merger in September 2024, and they made pretty grim reading for those pursuing the corporate nuptials. The most alarming findings were those concerning the impact the merger would have on the amount customers pay for their phone contracts. "Our merger simulation predicts that the merged entity's prices would rise by 7% for 3UK [Three] and 3.8% for VUK [Vodafone] on average," the CMA's report stated. "This, along with predicted price rises from the other retail providers, would lead to a harm to UK customers which is equivalent to at least £328 million per year, though our sensitivity analysis suggests that this could be as high as £1.1 billion."

> "This would lead to a harm to UK customers which is equivalent to at least £328 million per year"

It's not only the price of contracts bought directly from Three and Vodafone that could rise if they joined forces, but those of the virtual networks that use their infrastructure, too. "Faced with less competitive wholesale terms, MVNOs [virtual networks] would be less able to compete in the retail market, particularly in the low-cost segment where they tend to operate," the CMA stated. "This would lead to greater price increases than already outlined from the direct loss of retail competition resulting from the merger."

Still, with everyone's bills going up, surely there would be cold comfort in the fact that the merged entity would deliver better 5G coverage than they would be able to afford separately? And perhaps this would put pressure on BT/EE and Virgin Media O2 to improve their own 5G performance? Well, maybe not.

While the CMA conceded that the merged entity would likely deliver "some of the claimed network improvements efficiencies", in particular because the two parties could combine the spectrum they own separately, it concluded that the network quality benefits of the merger for consumers are likely to be "less than the parties have claimed".

"In particular, we consider that the parties may have the commercial incentive to retain a lower number of sites than claimed in the JNP [joint network plan] given the cost savings that can be realised through site decommissioning," the CMA added.

Widespread concerns

When the CMA conducts an investigation such as this, it takes submissions from a wide range of industry stakeholders, and many of those have also expressed concerns over the proposed merger.

Some of those have skin in the game. Nobody will be particularly shocked that rival BT concludes in its response to the provisional findings that "prohibition of the merger is both the only effective remedy and entirely proportionate," citing concerns over harm to consumers that were curiously absent when its own acquisition of EE was going through in 2016.

Virtual reality

If, as both the CMA and Sky suggest, the merger of Vodafone and Three will make it more difficult for the virtual networks to compete on price, that's going to harm one of the most popular sectors of the market.

A total of 13 mobile networks generated enough survey responses to be included in the Best Mobile Data Provider category in this year's *PC Pro* Technology Excellence Awards (*see issue 363, p28*). The bottom four places in the table were filled by the major networks: EE, Three, O2 and, worst of all, Vodafone.

Price is clearly a winning factor for the virtual networks. The average satisfaction rating of the four main networks on value for money was 70%. For the virtual networks, the average was 91%.

The table-topping 1pMobile, which piggybacks on the EE network, lives up to its name. Its pay-as-you-go plan costs 1p a minute, 1p a text and 1p per MB of data with no contract. Or you can buy a 10GB bundle for £8 per month. Lebara, which also did well in this year's survey, offers 5GB for £5. These networks scored 93% and 95% respectively for value for money.

Compare that to Vodafone, where the cheapest PAYG deal at the time of writing was £10 per month for 8GB of data (with 19GB extra for the first three months). Vodafone's value for money score in our awards? 67%.

However, there are some stronger independent voices raising fears over the impact of the merger. In its original response to the inquiry back in May, consumer group Which? stated that "our own evidence shows that the two firms compete closely for end consumers, and therefore that the merger risks less intense competition in the market on both price and quality".

Sky, which runs the UK's largest virtual network using Virgin Media O2's infrastructure, also argued strongly against the merger. "The merger would be particularly harmful to independent 'mass-market' MVNOs like Sky, whose successful existence depends on effective competition among MNOs [mobile network operators]," it claimed in a response to the provisional findings. "Notwithstanding any network improvements arising from the merger, this would significantly undermine any bargaining power we have and most likely prevent us from obtaining reasonable terms."

The merger conditions

If, as now seems likely, the CMA gives its blessing to the merger (a final decision was due in early December, after this magazine went to press), it will almost certainly come with a string of conditions.

The CMA's proposed remedies would force the merged company to deliver its joint network plan, which lays out how the firm plans to improve its performance and coverage over the next eight years. "This would be a legal obligation overseen by both Ofcom – the telecoms regulator – and the CMA," the competition watchdog proposes.

There will be some protections for consumers, too. The companies would have to commit to retaining their existing mobile tariffs and data plans for at least three years, "protecting millions of current and future Vodafone/Three customers (including customers on their sub-brands) from short-term price rises in the early years of the network plan," the CMA claimed.

And the virtual networks are also thrown a bone, with the merged entity forced to "commit to pre-agreed prices and contract terms to ensure that Mobile Virtual Network Operators can obtain competitive wholesale deals," according to the CMA, although details are fairly sketchy on the precise terms and duration of this remedy.

ABOVE The CMA seems likely to approve the proposed merger

There's some doubt over whether these remedies will prove sufficient. In a submission on potential remedies issued before the CMA published its own preferred remedies, Which? argued that "having Ofcom oversee and enforce remedies may be preferable, but will not be sufficient in itself to ensure compliance". It added that "mechanisms should be put in place to reimburse customers if remedies are breached, and a bespoke penalties regime may be needed to incentivise compliance".

Past history confirms that Ofcom hasn't been entirely hawkish when the mobile networks have failed to meet their legal requirements. For example, in 2013 Vodafone was found to have been the only network not meeting its obligation to provide 3G coverage to 90% of the UK population. The company wasn't fined, instead being given another year to sort it out.

Likewise, Three only just squeaked past compliance for rural network coverage earlier this year, with each of the four networks required to serve 88% of the UK's landmass by June 2024. Ofcom initially reported that Three had failed to meet the deadline, though it did manage to hit the target by late August. Again, no action was taken.

Three stronger than four?

Even with the potential for bills to rise and competition to be diminished, industry analysts think the merger of Vodafone and Three could be a good thing. "I think having three strong players – in other words, BT, Virgin Media O2, and the combined Vodafone/Three – is a better outcome for the market than having two that are strong – BT and Virgin Media O2 – and two that are sub-scale – Vodafone and particularly Three," said Kester Mann at CCS Insight.

> "We may see a small increase, but I think to be honest that's unlikely, and I think the CMA are coming around to that"

Being able to "draw more on scale economies would put the merged company in a far stronger position to challenge those two providers [BT and Virgin Media O2] and, of course, invest strongly into the market," he added.

Mann thinks the risks of huge price hikes were overblown. "Yes, we may see a small increase, but I think to be honest that's unlikely, and I think the CMA are coming around to that, and obviously there are some price guarantees that Vodafone and Three are putting forward," he said.

He concedes reduced competition might make life harder for virtual networks when it comes to haggling for contracts, but on the flip side the merged company will have "a bigger network with more capacity to fill, and therefore there are greater opportunities for the virtual providers".

As mentioned, the final decision is due in early December, with Mann claiming he would be "really surprised if it fails at this stage". And even if it did, both Vodafone and Three would soon "look at deals with other providers to get scale, because scale is such an important opportunity in the telecoms market". Get big or get out.

The A-List

The best products on the market, as picked by our editors

PC PRO A-LIST

PREMIUM LAPTOPS

NEW ENTRY

Apple MacBook Pro M4

M4 beast from £1,599

from apple.com/uk

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version from £1,599 or 16in from £2,499? And then how much do you upgrade, as Apple isn't afraid of high prices. But whatever you choose should last for years, and look great while it's doing it.

REVIEW **Issue 364, p50**

Apple Mac Book Air13in (M3)

Both the 13in and 15in MacBook Airs impress for speed, styling and battery life, but the 1.2kg 13in Air wins out of the two for its sheer portability. **From £1,299 from apple.com**

REVIEW **Issue 356, p54**

Asus Zenbook S 14 OLED

Asus pairs a Core Ultra 9 288V with a 72Wh battery to produce a laptop that lasts almost 20 hours on a charge. What's more, this 1.2kg machine looks (and feels) the business. **From £1,750 from scan.co.uk**

REVIEW **Issue 362, p46**

Asus ProArt PX13

With AMD's new Ryzen AI 9 HX 370 inside, this 1.4kg compact powerhouse offers incredible amounts of power. Add a fantastic OLED screen and RTX 4070 graphics and it's a winner. **From £2,000 from uk.store.asus.com**

REVIEW **Issue 361, p50**

BUSINESS LAPTOPS

Lenovo ThinkPad T14s Gen 6 (Snapdragon)

Copilot+ PC for £1,500 exc VAT

from lenovo.com

It's perhaps a controversial choice – and we wouldn't roll this out en masse – but if you're buying for executives or CTOs this cutting-edge Copilot+ PC, complete with a Qualcomm Snapdragon Arm processor, is a superb choice. Not only is it good value, it's light, it's fast and its all-day battery life is genuinely 24 hours.

REVIEW **Issue 360, p56**

Lenovo ThinkPad X1 Carbon Gen 12

The X1 Carbon range has stepped up a gear thanks to Intel's Core Ultra chips, and Lenovo matches it with the stunning build quality and keyboard you'd expect. **From £1,375 from lenovo.com**

REVIEW **Issue 358, p58**

Dell Latitude 9450 2-in-1

This 14in convertible, based around Core Ultra CPUs, lacks for nothing, whether that's speed, battery life (around 16 hours), build quality or flexibility. **From £1,560 exc VAT from dell.co.uk**

REVIEW **Issue 361, p63**

HP Dragonfly G4

It's not the fastest machine you can buy, but otherwise this 1kg masterpiece is as close as you're going to get to the perfect business laptop for executives. **From £1,380 exc VAT from hp.com**

REVIEW **Issue 352, p58**

COPILOT+ PCs

Lenovo Yoga Slim 7x (Gen 9)

AI on demand, £1,350

from lenovo.com

You won't find a better-value laptop, never mind one that meets the Copilot+ PC criteria. With a Snapdragon X1E-78-100 inside it isn't the fastest in benchmarks, but it's incredibly nippy in practice, the battery lasts over 16 hours and the 14.5in OLED screen is top quality.

REVIEW **Issue 361, p57**

Samsung Galaxy Book4 Edge

A classy 16in laptop that weighs 1.6kg, uses the fastest Snapdragon Elite X chip and delivers a solid 12 hours of battery life. **512GB, £1,499 from samsung.com**

REVIEW **Issue 360, p53**

Microsoft Surface Laptop, 7th Edition

The poster child for Copilot+ PCs offers quality, great looks and staggering battery life. **From £1,049 from microsoft.com**

REVIEW **Issue 360, p50**

Asus Zenbook S 15 OLED

With a price drop to £1,200 this 15.6in laptop becomes a viable competitor to the Yoga Slim 7x if you need a bigger screen. **£1,200 from uk.store.asus.com**

REVIEW **Issue 359, p52**

EVERYDAY LAPTOPS

Acer Aspire 14 A14-51GM

Compact power for £850

from acer.com

Want gaming power? Buy the version with RTX 2050 graphics for £850 (part code NX.KSVEK.005). Just care about value? Get a Core 5 processor and integrated graphics for £600 (part code NX.KRWEK.00B). Whichever you choose, it's a staggering laptop for the price.

REVIEW **Issue 359, p82**

Asus Zenbook 14 OLED (UX3405)

If you can stretch past £1,000, this is a top-quality Core Ultra laptop with a superb 120Hz screen and great battery life. **From £1,099 from uk.store.asus.com**

REVIEW **Issue 359, p58**

Framework Laptop 13 (DIY Edition)

With a competitive price, modular approach and easy-to-repair ethos, you can pick and mix your perfect 13in laptop. **From £779 from frame.work**

REVIEW **Issue 360, p58**

Huawei MateBook D16

It's big and certainly not bashful, packing an Intel Core i9 chip and a high-quality 16in panel – and surprisingly good battery life, too. **£1,000 from huawei.com**

REVIEW **Issue 359, p87**

CHROMEBOOKS

NEW ENTRY

Samsung Galaxy Chromebook Plus (2024)

Core 5 power for £749

from samsung.com

The first truly desirable Chromebook since the Pixelbook, this is a top-quality laptop from the all-metal chassis to the 15.6in Full HD OLED screen. And thanks to Intel's Core 5 120U processor, it's fast enough to last for years.

REVIEW **Issue 364, p65**

Acer Chromebook Plus 515

This Chromebook Plus laptop is all about value. With strong speeds thanks to Intel's Core i5-1235U processor, and a good-quality 15.6in panel with a 1,920 x 1,080 resolution, Asus' Chromebook Plus 515 is ideal for families, students and business users, providing mobility isn't your main priority as it isn't particularly light at 1.7kg. **£429 from currys.co.uk**

REVIEW **Issue 356, p82**

Acer Chromebook Spin 714

If you're looking for a convertible, this is the best choice around. Others may beat the 12th gen Intel Core i5 we tested for performance, but for features, design and bang for buck you won't find any laptop that can match this 2-in-1 for the money.**£799 from currys.co.uk**

REVIEW **Issue 356, p83**

MINI PCs

NEW ENTRY

Apple Mac mini M4

Little monster from £599

from apple.com/uk

This is a big and timely update for the Mac mini, with a much smaller (and squarer) design that's easy to tuck behind a screen. But what lifts it above the pack is the astonishing power of the M4 and M4 Pro chips, with barely any cooling required. As ever with Apple the upgrade costs are high, but at least its starting price is reasonable.

REVIEW **Issue 364, p44**

Geekom A8 Mini PC

Geekom makes brilliant use of AMD's Ryzen 9 8945HS in this powerful mini PC, which occupies little more desktop space than a drinks coaster. And it still packs every port most people need, plus Wi-Fi 6E. If you don't need this much power (or 32GB of RAM and a 2TB SSD) the Ryzen 7 version is £719. **Ryzen 9, £899 from geekom.co.uk**

REVIEW **Issue 359, p62**

Minisforum Venus UM790 Pro

Ignore its basic looks, for this compact system packs in a fast AMD Ryzen 9 7940HS processor, 32GB of DDR5-5600 RAM and 1TB SSD along with a generous selection of ports, including two USB-C 4 connectors. And the price is super-aggressive. **£549 from store.minisforum.uk**

REVIEW **Issue 363, p91**

ENTHUSIAST PCs

PCSpecialist Torpedo Ultra R

Compact RTX 4070 for £1,799

from pcspecialist.co.uk/reviews

This compact PC, built around the miniITX Corsair 2000D RGB AirFlow chassis, packs in a Ryzen 7 7800X3D, GeForce RTX 4070 graphics and 2TB of fast storage. The fans are noisy, but that's the price you pay for power.

REVIEW **Issue 363, p56**

CyberPowerPC Infinity X145 Elite

Designed to deliver the maximum possible gaming power for £999, this Core i5-14400F system – with 32GB of DDR5 RAM and GeForce RTX 4060 graphics – is a great machine now with potential for more later. **£999 from tinyurl.com/360cyber**

REVIEW **Issue 360, p61**

Palicomp AMD Destiny

An incredibly fast gaming PC for the money thanks to the wicked combination of AMD's Ryzen 7 7800X3D and Nvidia's GeForce RTX 4070 Super. With a fast 1TB SSD and 32GB of RAM in support, it's enough for smooth 4K gaming. **£1,799 from pcspecialist.co.uk/reviews**

REVIEW **Issue 360, p60**

ALL-IN-ONE PCs

NEW ENTRY

HP Envy 34 All-in-One

£2,099 widescreen wonder

from hp.com

Built around a high-quality 34in widescreen – which is perfect for viewing two windows side by side thanks to its 21:9 aspect ratio – this also comes with Nvidia RTX 3060 graphics. We're big fans of the magnetic 16-megapixel camera, too.

REVIEW **Issue 335, p46**

Dell Inspiron 24 All-in-One

Despite being built to hit a price point, the Inspiron 24 All-in-One manages to look classy, include a good-quality, 1,920 x 1,080 24in panel and have enough power to breeze through a typical day's tasks. It even packs mod cons such as a 720p webcam. Superb value for money. **From £599 from dell.co.uk**

REVIEW **Issue 350, p47**

Apple iMac M4

Anyone hoping for a 27in iMac will be disappointed, but everyone else should be delighted by this M4-powered all-in-one with its 24in 4,480 x 2,520 IPS panel. It's fast inside and out, too, with Thunderbolt 4 and Wi-Fi 6E on offer. **From £1,299 from apple.com/uk**

REVIEW **Issue 364, p48**

CREATIVE WORKSTATIONS

Armari Magnetar M64T7-AW1650G4

Threadripping power for £8,329 exc VAT

from armari.com

AMD's Ryzen Threadripper 7980X is the star of this particular show, dominating our benchmarks with the help of 128GB of RAM, two 2TB Crucial PCI-E 5 drives in RAID0 configuration and AMD's Radeon Pro W7800 professional GPU. And it's all wrapped up in a custom Armari case with liquid cooling.

REVIEW **Issue 361, p92**

PCSpecialist Quantum Goliath R

Extracting maximum power from its budget by opting for consumer components with professional levels of power, this well-thought-out workstation couples Intel's Core i9-14900KS with RTX 4090 graphics to tremendous effect. **£3,750 exc VAT from pcspecialist.co.uk/reviews**

REVIEW **Issue 361, p89**

Scan 3XS GWP A1-TR64

A more balanced offering than Armari's Magnetar, Scan mixes a Threadripper 7970X with Nvidia RTX 5000 graphics – and a stunning supporting cast of components with an equally stunning case. Perfect for real-time viewsets and GPU accelerated computation. **£7,917 exc VAT from scan.co.uk**

REVIEW **Issue 361, p94**

TABLETS

NEW ENTRY

Apple iPad Air (M2)

M2 power from £599

from apple.com

We love the new iPad Pro, but for most people the M2 iPad Air is not only far better value but also all the tablet they'll need. It supports the Magic Keyboard and Pencil Pro, plus it's now available in both 11in and 13in sizes.

REVIEW **Issue 358, p50**

Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing £1,299. **From £999 (11in, 256GB) from apple.com**

REVIEW **Issue 358, p48**

OnePlus Pad 2

Last year the OnePlus Pad took its place alongside Apple's iPads on the A List – and this year it's done it again, with superb battery life of over 18 hours, a gorgeous design and great power making this new version an even better proposition. All for a price that's exactly right. **£449 from oneplus.com/uk**

REVIEW **Issue 364, p86**

EVERYDAY PHONES

Motorola Moto G54 5G

Great looker for £180

from johnlewis.com

The 6.5in 120Hz IPS display is the G54's standout feature, but it improves on the previous generation in numerous ways while being even cheaper. It's faster, looks better, takes great photos and battery life is strong. You won't find better for less than £200.

REVIEW **Issue 355, p77**

Google Pixel 8a

We're fans of the Pixel 8 but you can save £200 and buy the 8a without missing out on any key features, including its advanced AI skills thanks to the same Tensor G3 chip inside. It's only when you zoom into snaps that you spot the camera quality difference. **128GB, £499 from store.google.com**

REVIEW **Issue 358, p74**

Samsung Galaxy A55

Not the fastest phone on the market, but in return you get a high-quality 6.6in OLED display, excellent battery life and a trio of strong cameras. And you also get four years of feature updates. With a price that significantly undercuts the Pixel 8a, it's great value, too. **128GB, £364 from johnlewis.com**

REVIEW **Issue 358, p77**

PREMIUM PHONES

Apple iPhone 16 Pro

Class and quality from £999

from apple.com/uk

Even without Apple Intelligence, the introduction of a 5x optical zoom, classy 6.3in OLED panel and Apple's ludicrously fast A18 Pro chipset make this the best update to an iPhone Pro for years. The improved battery life is merely the cherry on top.

REVIEW **Issue 363, p70**

Honor Magic V3

With the Magic V3, not only does Honor make foldable phones as slim as flagship phones but also as affordable – so long as the £300 discount voucher still applies, as shown in the price here. What's more, the cameras and both OLED panels are superb. **£1,400 after discount from honor.com**

REVIEW **Issue 362, p62**

Motorola Razr 50 Ultra

Not merely a huge upgrade over last year's Razr 40 Ultra, this new model also leapfrogs over Samsung's new Flip6 to become our flip phone of choice. That's thanks to its great battery life, superb screens (particularly on the outside) and a camera that's a joy to use. **£1,000 from motorola.co.uk**

REVIEW **Issue 360, p68**

EVERYDAY MONITORS

Iiyama ProLite XUB3293UHSN-B5

32in 4K bargain, £429

from currys.co.uk

The fact that this 31.5in IPS monitor could compete so well against Eizo's alternative (*see below*) says it all. Great colour coverage in sRGB and DCI-P3, USB-C and RJ45 inputs, plus solid build quality add up to a bargain.

REVIEW **Issue 357, p88**

AOC Q27B3CF2

AOC's relentless focus on value delivers a 27in 1440p screen with a high-quality IPS panel that costs £200 including VAT – and also packs in a USB-C port. Those are almost the only features you get, and the OSD is awful, but at this price we're not complaining. **£200 from amazon.co.uk**

REVIEW **Issue 360, p77**

Acer Verso B277 Ebmiprzxv

This is a basic but high-quality monitor, delivering colourful images across its 27in Full HD diagonal. You don't get USB-C docking, but it includes VGA, HDMI and DisplayPort inputs, plus a two-port USB hub. **£149 from tinyurl.com/357acer277**

REVIEW **Issue 357, p84**

PROFESSIONAL MONITORS

Eizo FlexScan EV3240X

Stunning 4K quality, £1,206

exc VAT from photospecialist.co.uk

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.

REVIEW **Issue 357, p91**

Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage, too. **£2,149 exc VAT from wexphotovideo.com**

REVIEW **Issue 357, p90**

BenQ PD2706U

If you can't stretch to Eizo budget levels then this 4K 27in screen is definitely worth investigating. It has several features aimed at professionals, including a Hotkey Puck to switch between profiles, plus great coverage of the sRGB and DCI-P3 gamuts. **£333 exc VAT from scan.co.uk**

REVIEW **Issue 357, p86**

WEBCAMS

Logitech MX Brio 705 for Business

Consistent brilliance for £219

from logitech.com

Consistent image quality in all lighting conditions coupled with top build quality and nifty features – such as a presenting mode for items on your desk – make this a fantastic all-round choice.
REVIEW **Issue 356, p68**

Logitech Brio 105 for Business

While you can buy 1080p webcams for a third of the Brio 105's price, they won't hold a candle to the Logitech webcam's quality – especially in low-light conditions, such as one candle. It's also easy to manage, for businesses and individuals.
£45 from logitech.com
REVIEW **Issue 360, p77**

Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.
£329 from amazon.co.uk
REVIEW **Issue 352, p75**

HOME OFFICE PRINTERS

Epson EcoTank ET-2830

Ink tank all-in-one for £250

from epson.co.uk

Don't expect flashy features, but do expect fast print speeds, high-quality prints, scans and copies, plus phenomenally low running costs – even after you've exhausted the 6,000 pages' worth of bottled ink that comes with it.
REVIEW **Issue 353, p85**

Canon Pixma TS8750

A fantastic choice for creative users that's equally at home printing photos as it is scanning artwork. Despite its high running costs, due to its reliance on cartridges, this is a superb all-in-one. **£159 from printerbase.co.uk**
REVIEW **Issue 353, p86**

HP OfficeJet Pro 9012e

So long as your print volumes aren't huge – the running costs mount up – this is a superb all-in-one for home office usage. It's fast, robust, prints double-sided and produces strong all-round results.
£208 from printerland.co.uk
REVIEW **Issue 353, p87**

WORKGROUP PRINTERS

Canon Maxify GX6550

Ink tank all-in-one for £392 exc VAT

from canon.co.uk

Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.
REVIEW **Issue 350, p58**

Brother HL-L9430CDN

This laser printer (not an all-in-one, so there's no scanning or copying functionality) is a great choice for a busy office, producing sharp black text and making a good job of colour graphics as well. All while doing so quickly with a competitive price per page. **£415 exc VAT from printerland.co.uk**
REVIEW **Issue 353, p84**

Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies. **£238 exc VAT from printerbase.co.uk**
REVIEW **Issue 341, p87**

WIRELESS ROUTERS

Netgear Nighthawk RAXE300

Fast Wi-Fi 6E router, £350

from amazon.co.uk

The RAXE500 is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.
REVIEW **Issue 341, p68**

Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.
£800 from netgear.com
REVIEW **Issue 353, p76**

Asus RT-AX59U

You can buy cheaper Wi-Fi 6 routers – such as the D-Link Eagle Pro AI R15 for £55 – but Asus' well-priced offering delivers strong performance along with lots of control and exceptional VPN support. **£125 from uk.store.asus.com**
REVIEW **Issue 350, p57**

MESH WI-FI

NEW ENTRY

TP-Link Deco XE200

Clever Wi-Fi 6E for £400

from amazon.co.uk

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code B0BKTDPWC8) should be enough for most premises.
REVIEW **Issue 349, p65**

Netgear Orbi 770

If you're eager to upgrade to Wi-Fi 7 then the Orbi 770 is the best mesh option yet. Its speed and range are both excellent, with a twin-pack covering 420m² (says Netgear), and the wired connectivity superb: four 2.5GbE connectors on the router unit, two 2.5GbE ports on the satellites. But it ain't cheap. **2-pack, £600 from amazon.co.uk**
REVIEW **Issue 364, p70**

Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house. **2-pack, £380 from amazon.co.uk**
REVIEW **Issue 350, p54**

BUSINESS WI-FI

Zyxel WAX640S-6E

Wi-Fi 6E AP, £369 exc VAT

from broadbandbuyer.com

A nicely priced tri-band wireless access point ideally suited to businesses that want to provide the full range of wireless services. It's easy to deploy, wireless performance is good and Zyxel provides top-quality cloud management services.

REVIEW **Issue 353, p100**

TP-Link Omada EAP783

This slim-line discus has a mighty BE19000 rating and will appeal to businesses looking to make an early transition to Wi-Fi 7. It delivers superb performance and is MLO-ready, while TP-Link's Omada cloud platform offers great remote management services. **£520 exc VAT from senetic.co.uk**

REVIEW **Issue 360, p103**

Ruijie Reyee RG-RAP2260(E)

This competitively priced Wi-Fi 6 AP delivers business-class features and impressive performance, and the free Ruijie Cloud service offers a wide range of remote network management and monitoring tools. **£160 exc VAT from broadbandbuyer.com**

REVIEW **Issue 359, p103**

NAS SERVERS

Synology DiskStation DS1823xs+

10GbE NAS, £1,413 exc VAT

from broadbandbuyer.com

This powerful eight-bay NAS is a great choice for SMBs that want plenty of capacity, features and performance at a reasonable price. The new DSM 7.2 software has security high on its agenda, and the icing on the cake is Synology's generous five-year warranty.

REVIEW **Issue 346, p101**

Qnap TS-h987XU-RP

The TS-h987XU-RP is a ready-made hybrid storage solution for SMBs. This rack-friendly package offers a great specification for the price, and Qnap's QuTS hero software scores highly for its wealth of data-protection features and business apps. **Diskless, £3,292 exc VAT from broadbandbuyer.com**

REVIEW **Issue 344, p96**

Synology DiskStation DS1522+

Small businesses that want a high-capacity desktop NAS at a good price will find Synology's DS1522+ a great choice. Performance over 10GbE is impeccable and the DSM software offers a fantastic range of storage features. **5-bay NAS, diskless £586 exc VAT from broadbandbuyer.com**

REVIEW **Issue 344, p98**

VIDEOCONFERENCING

NEW ENTRY

Biamp Parlé VBC 2800

Go big for £2,918 exc VAT (MSRP)

from midwich.com

We thought the VBC 2500 was a great VC room bar, and the new VBC 2800 delivers Biamp's undeniable expertise to larger meeting rooms. Video and audio quality are outstanding, speaker framing is super fast and the smart combination of dual camera lenses makes sure everyone is in the big picture.

REVIEW **Issue 364, p98**

NEW ENTRY

Owl Labs Medium Room Solution

The Owl 4+ and Owl Bar partnership offers smart tracking and dynamic split-screen views to ensure everyone is in the picture, while the Whiteboard Owl adds extra professionalism to presentations and training sessions. **Owl 4+, Owl Bar, TV mount, £2,999 exc VAT from owllabs.co.uk**

REVIEW **Issue 364, p100**

NEW ENTRY

Ricoh Meeting 360

Ricoh's Meeting 360 is up against stiff competition in the panoramic meeting hub market but stands out for its excellent build quality and generous three-year warranty. It's easy to use and delivers good video and audio quality, while the smart app allows you to create a view for every occasion. **£744 exc VAT from amazon.co.uk**

REVIEW **Issue 364, p101**

SCANNERS

Xerox N60w Pro Scanner

Speed demon, £766 exc VAT

from tradescanners.com

The N60w Pro offers tremendous value and versatility. It delivered up to 67ppm in our tests with great output quality, offers a plethora of connection options and makes walk-up scanning a breeze.

REVIEW **Issue 358, p101**

Brother ADS-4500W

Ideal for small businesses, the ADS-4500W offers a fine set of walk-up scan features and its output quality is beyond reproach, while Brother's Print&Scan app delivers great scan workflow management options. **£295 exc VAT from printerbase.co.uk**

REVIEW **Issue 358, p98**

Epson WorkForce ES-C320W

A space-saving wireless desktop scanner, the Epson WorkForce ES-C320W delivers nippy speeds – around 31ppm in our tests – and is backed with software that offers plenty of scan management features. **£180 exc VAT from printerland.co.uk**

REVIEW **Issue 358, p100**

SERVERS

Dell EMC PowerEdge T350

Xeon E-2300 power, from £1,399 exc VAT

from dell.com

Perfect for SMBs and branch offices looking for an affordable and powerful single-socket tower server. Along with support for Xeon E-2300 CPUs and lots of memory, it has a high storage capacity, plenty of expansion space and is sturdily built.

REVIEW **Issue 335, p98**

Dell EMC PowerEdge R250

With prices starting at around £850 exc VAT for a Pentium Gold CPU, and the option of Xeon E-2300 series chips from £1,461 exc VAT, this is a slim, rack-mounted alternative to the more high-powered T350 that's ideal for SMBs. **From £845 exc VAT from dell.com**

REVIEW **Issue 332, p98**

Broadberry CyberServe Xeon E-RS100-E10

This represents a powerful hardware package at a price that will please small businesses. We love its low-profile chassis and the fine selection of remote-management tools. It's a great alternative to the Dell EMC servers also listed here. **£983 exc VAT from broadberry.co.uk**

REVIEW **Issue 318, p96**

SECURITY SOFTWARE

Avast Ultimate
Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection. **10 devices, 2yrs, £30 from store.pcpro.co.uk**
REVIEW **Issue 355, p84**

G Data Total Protection
G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system, making it a favourite despite its quirks. **5 devices, $82 from gdatasoftware.co.uk**
REVIEW **Issue 355, p87**

Avast One Essential
Avast One Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools. **Free from avast.com**
REVIEW **Issue 355, p89**

VPNs

Surfshark
Reliably fast and goes out of its way to ensure that international streaming services work. Surfshark has a credible track record for privacy, too. **£55 for 27 months from surfshark.com**
REVIEW **Issue 360, p87**

NordVPN
One of the best all-purpose consumer VPN services around, and the paid-for version is packed with features – from anti-malware tools to a rather clever mesh file-transfer system. **£94 for 27 months from nordvpn.com**
REVIEW **Issue 360, p85**

Proton VPN
A great VPN in its own right, but also the best free VPN service as you get unlimited data. Instead, Proton restricts which endpoints you can access to only three countries: the USA, the Netherlands and Japan. **Free from protonvpn.com**
REVIEW **Issue 360, p86**

PASSWORD MANAGERS

NordPass
This hassle-free option is a great choice for both personal and business use, with a competitive price matched with all the features most people need. **£1.89 per month from nordpass.com**
REVIEW **Issue 350, p70**

Bitwarden
Free for individual use and open source, the only important thing Bitwarden lacks is phone support: it works with virtually every device and browser, and the paid option is well worth £10 per year. **Free from bitwarden.com**
REVIEW **Issue 350, p71**

Keeper
A great choice for businesses thanks to its focus on security and a zero-knowledge policy, and if you need more options then Keeper has them. **Business edition, from £2 per user per month from keepersecurity.com**
REVIEW **Issue 350, p72**

ON-PREMISES BACKUP

Nakivo Backup & Replication 10.11.2
Perfect for SMBs that want the freedom to choose their host system. It supports an incredible range of hardware platforms and OSes and is packed with data protection features. **Enterprise, 10 servers, perpetual licence, £1,118 exc VAT from nakivo.com**
REVIEW **Issue 362, p100**

Veritas Backup Exec 23
Backup Exec 23 is easy to manage, provides valuable ransomware protection and the subscriptions are great value. **Simple Core Pack, 5 instances, £498 exc VAT per year from uk.insight.com**
REVIEW **Issue 362, p101**

CLOUD BACKUP

IDrive Business
A top cloud backup choice for SMBs that want to protect on-premises systems and remote workers. Platform and business app support is outstanding, it's easy to use and the simple capacity-based subscriptions are incredibly good value. **5TB, £838 exc VAT per year from idrive.com**
REVIEW **Issue 359, p101**

Acronis Cyber Protect 16 Advanced
Flexible subscriptions keep costs under control, the EDR service stays one step ahead of cybercriminals and it's easy to manage, too. **From £95 exc VAT per year from acronis.com**
REVIEW **Issue 359, p98**

VOIP SERVICES

3CX Phone System V20
Our top choice for businesses that want to manage their own VoIP system. It can be hosted in the cloud or on-premises, and has lots of new features. **Small Business, 10 users, £175 exc VAT per year from 3cx.com**
REVIEW **Issue 357, p98**

TelephoneSystems.Cloud
A great choice for businesses that know what they want from cloud-hosted VoIP services, offering a wealth of features at a good price. **From £11 exc VAT per user per month from telephonesystems.cloud**
REVIEW **Issue 357, p100**

ENDPOINT PROTECTION

WithSecure Elements Endpoint Security
A comprehensive set of protection measures for a great price, easily managed from a cloud portal. It supports a wide range of devices and the Luminen tool delivers AI-powered reporting services that present detailed summaries of events with a click. **100-499 devices, £37 exc VAT each per year from withsecure.com**
REVIEW **Issue 363, p101**

Sophos Intercept X Advanced
An unbeatable range of tough security measures. Deployment is a breeze, and a multitude of security policies make it highly flexible. **100-199 users, £48 exc VAT each per year from enterpriseav.co.uk**
REVIEW **Issue 363, p98**

REMOTE SUPPORT

NetSupport Manager 14.1
Sets the standard for on-premises hosted support for local and remote workers. It delivers a remarkable range of features and its one-time cost per seat will appeal to businesses concerned about subscription fees. **1-500 systems, perpetual licence, £10 each exc VAT from netsupportmanager.com**
REVIEW **Issue 361, p100**

ISL Online Standard
Perfect for SMBs wanting cloud-based support. Features and access security are excellent, as are its flexible licensing plans. **Standard Cloud/One user, £287 exc VAT per year from islonline.com**
REVIEW **Issue 361, p99**

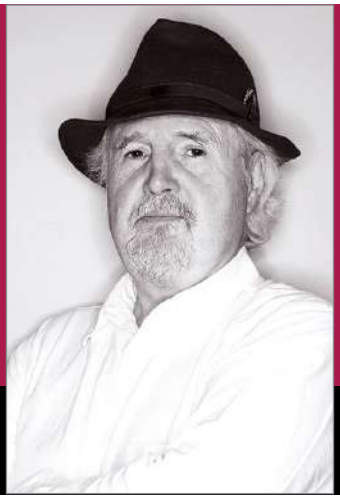
SECURITY APPLIANCES

NEW ENTRY

Firewalla Gold Pro
A great choice for small businesses that delivers a wide range of security features at a tempting price. Our 10GbE tests show it can easily cope with high demand, and you don't have to worry about subscriptions either, as the price includes all security services and lifetime updates. **$899 (£676) from firewalla.com**
REVIEW **Issue 364, p103**

DrayTek Vigor 2927Lax-5G
This affordable security router offers always-on internet access thanks to an unbeatable set of WAN redundancy features and also offers built-in Wi-Fi 6 services. **£667 exc VAT from broadbandbuyer.com**
REVIEW **Issue 360, p98**

In praise of the mighty PDF



Dick Pountain is editorial fellow of *PC Pro*. He thinks PDFs are Pretty Damn Fine. Email dick@dickpountain.co.uk

The PDF is a brilliant format even after all these years, and a long search for the perfect app to read them on has finally paid off

Besides all that arty stuff I wrote about in last month's column, I also review books. Not novels, self-help or pop science books, but rather heavier subjects such as political economy, and evolutionary and social psychology. Some of these tomes get big (I mentioned a 1,000-page job back in issue 315), and note-taking for such a behemoth is hard work. That's why I was delighted to discover the notation abilities in Kindle ebook editions, which I've also mentioned in previous columns. The ability to bookmark pages, search for keywords and add comments – plus to cut and paste notes and quotes – has become essential to my way of working.

Regrettably or otherwise, Amazon's dream that Kindle editions could wholly take over the book business hasn't materialised, with sales stagnating or declining and, more importantly for me, few of the academic publishers I deal with still producing Kindle editions. However, they do all produce PDF versions, used internally for proofreading and so on. Hence, when soliciting a review copy I now always ask for a PDF too.

The facilities provided in a PDF are sometimes sparser than those in Kindle Reader, depending on the settings used by the publishers and designers when outputting them, and so the capabilities of PDF readers have become a vital issue to me. I started out as everyone does with Adobe Reader, but found it less and less satisfactory over the years, and not just because of Adobe's grabby pricing structure – it's become way too slow to navigate and search my biggest books.

> "Before biting the bullet and buying a new computer I decided to try all the PDF readers in the Play Store"

Thankfully, as I mentioned in issue 315, I have discovered a far better PDF viewer: the Chrome extension PDF.js, which is a free GitHub project built with HTML5. I'd been using this happily for several years until recently a Google change to ChromeOS stopped it working, and my Chromebook is too old to support the OS update now required. Before biting the bullet and buying a new computer I decided to try all the PDF readers in the Play Store.

What a horror show that turned out to be. There are hundreds of them, nearly all crap. It appears every wannabe Android developer from Lapland to New Zealand writes one as his apprentice piece, then bungs it online to reap two-star reviews. All assume you're using a phone rather than a Chromebook, each offers its own wretched file management, and few can see external USB drives at all, so I soon became Olympian fast at the "install-swear-uninstall" cycle. Scouring the forums yielded recommendations for phone users only, few understanding requirements as demanding as mine. Then one glorious day in October I found Readera, which does almost everything that Kindle does (and a few things more) at remarkable speed and with a very comfortable UI.

Not only does Readera open every ebook format you've heard of, on Windows, Apple or Android, it does it for free without ads. And not only does it see external USB drives but its own PDF manager is actually superior to Android's. I used the free version for several weeks, but the developer lured me into spending £14.49 (one-off) on the Premium upgrade: this offers colour-coding for notes, which I'd started using under Kindle but then lost with the Chrome extension.

> "I must stress I'm not a pirate who re-sells or wishes to profit from such copies – they're just aides memoire for my writing"

An unexpected side-effect is that I've started using PDFs for all sorts of purposes besides book reviewing. I've always known you can print documents to PDF rather than a physical printer via the system print dialogs in Windows, ChromeOS, Android and I imagine iOS too, but I'd never found much use for this until recently. When I started having problems saving web pages to Pocket for various reasons, the penny dropped – save to PDF instead and store the file locally rather than in Pocket's cloud. Some websites offer a download option, but for those that don't, save-to-PDF often works and retains all formatting and colour pictures.

I must stress I'm not a pirate who re-sells or wishes to profit from such copies – they're just aides memoire for my writing of both book reviews and this column. For many years I used browser bookmarks, but weblinks can break or just vanish and the bookmark hierarchies in many browsers have become unwieldy. My local folder for this column has subfolders such as AI, Bio_Neuro and Quantum, full of PDFs from journals such as *Nature*, which I can find quickly to swot up or quote from.

There's one more thing that I'd like: a good grep-like utility that searches for text within multiple PDFs. Adobe Reader does this but its file management has irritating limitations, so occasionally I fantasise about writing one in Python (and bunging it in the Play Store to reap my own two-star reviews), but the feeling soon passes.

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Forget sci-fi: I want tech realism

Fitting believable technology into movies isn't easy, but it's high time we acknowledged the reality of our world

Nicole Kobie is *PC Pro*'s Futures editor and she doesn't even have a driving licence any more, so what she really wants is a movie about a bus. Someone call Keanu.
@njkobie

"What's your favourite sci-fi?" I've been asked this a few times on podcasts and radio shows, but I lack a good answer. I tend to say "Margaret Atwood, because I'm a depressing Canadian", but that's because I think it's a good line, or at least better than saying "umm" for a minute before pretending the connection dropped.

I'm not being asked about science fiction because I write it. It's because I wrote a book about tech non-fiction, and it turns out that even when I'm trying to bring reality to discussions on innovation and futurism, people want to ask about fictional versions. Sci-fi clearly informs how we think about technology and how we imagine its impact, which is intriguing given how full of tech our lives actually are – we don't have to imagine what technological disruption feels like as we've lived it.

Anyway, I'm not massively into science fiction. *Star Trek* or *Star Wars*? Don't care about either, I'm afraid. I'd rather see technology deployed cleverly in other genres of film. Some have tried this, with rom-coms putting text messages up on the screen to mimic how we all actually talk to each other about relationships these days, but technology is generally written out of the picture as quickly as possible. Thrillers don't work as well when you can just text your friends who the killer really is, and – as is often pointed out online – *Home Alone* would be a very different film with in-air internet, Ring cameras and the rest. Film-makers may also want to avoid dating their stories, as years-old tech will age any film or TV show.

> "The goofiness of modern technology could be used to humorous effect to reboot tired film tropes"

But current technology could make for decent plots. How about a reimagined *Office Space* where they're losing their jobs over AI that turns out not to work very well? Actually, don't remake *Office Space*. It's perfect as is. But how about a film where someone gets fired or kicked out of uni because they submit work that says "As an AI language model, I cannot..."? If nothing else, it would offer a good lesson to audiences about how not to use generative AI.

The goofiness of modern technology could also be used to humorous effect to reboot tired film tropes. Take car chases. I want someone who truly understands modern technology in cars to choreograph a car chase scene. In order to make their escape, our bad guy leaps into a Tesla, grabs the phone of the driver and boots them out the door. Hitting the motorway, the car can drive, so the baddie can hang out the window and shoot at our protagonist. The audience marvels at the technical capability of the car, until... wham! the car carrying the bad guy slams into a light-coloured truck stopped alongside the shoulder of the road.

Or maybe the criminal organisation acting as the bad guys in my unnamed film books dozens of driverless car taxi rides from an art gallery, a bank or whatever MacGuffin of an institution in San Francisco, LA or Phoenix. Why those cities? Because Waymo operates there. When the cars arrive, they dump traffic cones on their sensors. With the streets around the target blocked by unmoving driverless cars, the bad guys make their escape unhindered by police on the other side of the high-tech roadblock.

But that's driverless. The scene I really want to see is set on a British motorway, with our plucky protagonist trying to catch up to the bad guy amid commuter traffic – but the car they've nicked won't go over the posted speed limit, because it has automated speed controls!

Disabling those, our protagonist tries again, speeding up enough to reach ramming range. Slamming their foot on the accelerator, they fly towards the car ahead until it suddenly hits the automated emergency brake, avoiding the intentional fender bender. Foiled, they drive up alongside the antagonist, hoping to swipe them from the side – only to be prevented from swerving into the other car by lane-keeping systems.

> "When I'm trying to bring reality to discussions on innovation and futurism, people want to ask about fictional versions"

Forget the car leaping scenes of *Fast and the Furious*, the slide down the stairs in *The Italian Job*, the perfectly choreographed chases of *Baby Driver*. I want to see someone try to smash out of the controls enforced by our tech systems, though that might be less a comedy and more a tragedy at this point.

A bit of tech realism might help reduce our reliance on the fantasies of science fiction. Movies don't need to be perfect reflections of our real world – that would be dull, after all – but we need to find a way to fill the gap a bit better between bad tech on the screen and sci-fi visions of the future. If nothing else, it might help us better understand the technology we do have – and give me a better answer for podcasts, too.

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An even longer trip on the M1

Apple silicon has completely ripped up my laptop replacement cycle, which is bad news for family members waiting for cast-offs

Barry Collins is a former editor of *PC Pro* and shouldn't be left alone with any hot implements, bar a coffee mug. Send Starbucks vouchers to barry@mediabc.co.uk
@bazzacollins

There are two extremes on the *PC Pro* kit-buying spectrum. At one end, there's Jon Honeyball, spending the GDP of Norway every few months so that he can have the latest iPhone, Macs and other Apple doodads at their wallet-stretching top spec. At the other, there's Lee Grant soldering together an Etch-A-Sketch and a Nokia 3210 to form a fully compostable "smartphone".

I like to think I'm somewhere in the middle, the *PC Pro* everyman. I don't splash out on kit all that often, but when I do I tend to go premium, especially when it comes to my work computer. Ever since I've been choosing my own work equipment, I've bought a high-end laptop to see me through the next three years.

Why three years? Well, in my experience, even high-end laptops start to puff their cheeks and need a little sit down when you ask them to do something demanding after three years. Plus, the batteries are on the turn and the extended warranties have expired. The laptop's normally still serviceable: my 2015 ThinkPad has only just retired from active duty as my daughter's college workhorse, in fact. But for the daily eight-to-six grind of running Outlook, InDesign, Photoshop, Audition and a browser stuffed with more tabs than a Manchester nightclub, three years is the limit. Or at least, it was.

When Apple recently launched its dinky M4 version of the Mac mini (*see p44*), I'll admit to being sorely tempted. That tiny unit would be way more powerful than my current M1 MacBook Pro, yet it's so small it would fit comfortably on the base of my monitor's stand, clearing a sizeable chunk of desk space. I'd need a second screen to replace the laptop's display, but given the Mac mini is thunderously cheaper than a MacBook Pro – even after you've paid the ridiculous Apple premium to get sufficient storage – that wouldn't be a problem.

The problem is justifying replacing the MacBook Pro in the first place. Yes, it's just shy of its third birthday and theoretically ready for retirement under the patented Collins Replacement Cycle™. But there's still nothing I do on a daily basis that causes the MacBook Pro to start perspiring around the speaker grilles. Nothing. I run a fantastic little app on my MacBook called iStat Menus that keeps track of all manner of diagnostics, and it tells me that in the past 28 days, my CPU load has only "peaked" over 35% once. I've still got more headroom than Sandi Toksvig in an aircraft hangar.

Over that same month-long period, the Mac's memory pressure – a metric that basically shows how much genuine strain the memory is under – has never surpassed 50%. And when I bought this MacBook, I worried I'd underspecced it by only going with 16GB of RAM.

The 1TB SSD has still got more than 400GB of spare capacity (I store my photos on an external SSD) and has a reported health of 98%. The fans have only turned on once in the past month, iStat Menus tells me, and they must have been whisper-quiet as I didn't hear them. The battery will still go for hours and hours, and has a reported health of 83% – much helped, it seems, by macOS automatically limiting the charge to 80% of capacity when the laptop remains chained to the mains for days at a time.

> "I don't splash out on kit all that often, but when I do I tend to go premium, especially when it comes to my work laptop"

> "In the past 28 days, my CPU load has only 'peaked' over 35% once. I've still got more headroom than Sandi Toksvig in an aircraft hangar"

In short, there's not a single factor I can point to that remotely justifies replacing it. It's not quite as good as the day it dropped off the FedEx van – it does have the odd stumble, as any laptop laden with three years' worth of cruft will inevitably have – but it's far more than capable of anything I need it to do. The only exception is high-end gaming, but that's not really its purpose in life – and I've got GeForce Now for that anyway.

Apple silicon has completely reset the clock in terms of expectations of how long a laptop will live. Unless something goes drastically wrong or the battery life drops off a cliff, I can easily see this MacBook lasting four, maybe even five years as my daily driver. And though it was relatively punchy when I bought it (£2,338, since you ask), if you spread that over four or five years, it's going to be cheaper than any Windows laptop I've ever bought on an annual cost basis.

In fact, my biggest worry now is the end of Apple Care+, because if I drop it a smashed screen will probably make the repair uneconomical compared to buying a new Mac mini.

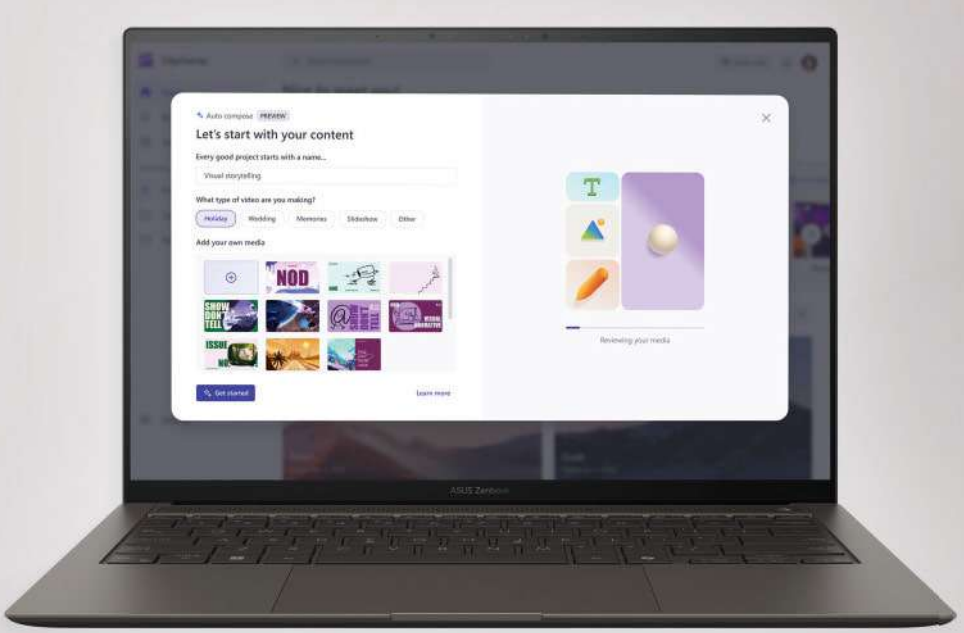
Still, given that every other laptop I've owned has been ripe for retirement after only three years, I guess I can consider any extra time I get with this MacBook Pro as a welcome bonus. And it means I've shifted further towards the Grant end of the *PC Pro* kit-buying spectrum. Does anyone know how to use a soldering iron?

barry@mediabc.co.uk

ASUS

ASUS Lumina OLED

PC PRO TECHNOLOGY EXCELLENCE AWARDS 2024


Let's start with your content
Every good project starts with a name...
What type of video are you making?
Add your own media
Get started
Learn more
Reviewing your media

Meet the ASUS Zenbook S 14

The laptop that works as hard as you do. With its ultra-slim design, vibrant OLED display, and all-day battery life, it's built to keep up with your busy lifestyle.

Thin and light
1.1 cm, 1.2kg all Metal body

High-tech ceramic: Ceraluminum™
Light, enduring and long-lasting

3K ASUS Lumina OLED
Bring all your visuals to life

Windows 11

Create captivating video content

Scan to learn more

Readers' comments

Your views and feedback from email and the web

Big up the British?

I enjoyed your Technology Excellence Awards article (*see issue 363, p28*) and noted the award of "Best of British" to PCSpecialist for its laptop service. Would you consider adding the nation of origin to the specs of hardware and software reviewed in the magazine? Many readers, I am sure, would be eager to support British businesses if given the choice.

Dr John Urquhart

Editor-in-chief Tim Danton replies: Thanks for the suggestion but my inclination is not to do this. That's partly because I have to keep the specs box a certain size, and people often ask me to add things to them, but also because we try to mention in the review if a company is British (sometimes even mentioning where they're based in the country). But I'm open to argument if people feel strongly otherwise.

ABOVE Should we print the country of manufacture in our specs box?

Satisfaction vs reception

In the Mobile Data Provider section of your recent Excellence Awards I noticed that 4G and 5G satisfaction were higher for 1pMobile and Smarty than for their parent networks.

Is this telling us something about access to the parent and virtual networks, or is it simply variance within the expected range of accuracy of the survey?

Steve Smith

Editor-in-chief Tim Danton replies: A good and perennial question! The key word there is "satisfaction". If you're paying £30 per month and don't get great 4G, then you're likely to be less satisfied than someone paying £10 a month, even though the 4G reception you receive is precisely the same. I hope that clears this up!

Grim Outlook

Having been a user of the desktop version of Microsoft Outlook for many years, currently with an Office 365 subscription, I was interested to read Lee Grant's description (*see issue 363, p113*) of Outlook for Windows as a viable replacement/update. There's just one problem. It only works with IMAP systems and is no good for those of us who prefer to store our emails locally, using POP.

Peter Johnson

Contributing editor Lee Grant replies: Your preference for locally stored email is not uncommon, and although Outlook for Windows supports POP3, Outlook PST integration won't arrive until March 2025. I suspect that Outlook for Windows won't support local PSTs. Offering to accommodate your carefully curated 3GB PST into 1TB of 365 storage is a great opportunity for Microsoft to upsell. You could use a hybrid method. Use Outlook for Windows' new features to clean your mail, then pull it to Outlook 365 for storage. Clunky, but possible.

Silence is golden

Your Mini PCs Labs (*see issue 353, p78*) was fascinating, but it was missing a totally silent solution. For the last month I have been the proud owner of a Quiet PC UltraNUC Pro 14 Fanless; as the name suggests, this is based on the Asus NUC 14 platform, but inside an Akasa Turing case. This has replaced an Intel Ghost Canyon with a Core i9 processor. Despite the new PC having only an i5 processor, it's noticeably faster. Power consumption is about half and the silence is... blissful. I'm using a state-of-the-art 6K Dell monitor, which is also a joy to work with.

The only drawback so far is that you have to peer behind the screen at the power LED to see whether it's switched on (as the PC sits behind the screen), for example when the screen has gone to sleep, and the power switch itself, which is too small.

Constantine Goulimis

Buggy monitors

Should I have my computer monitor screened for nits?

Peter B Thomas

Editor-in-chief Tim Danton replies: You win the award for our shortest letter ever! So, some people say nits to indicate brightness but we use the more scientific-sounding cd/m² (candela per square metre). However, they're exactly the same.

Video doorbell knocker

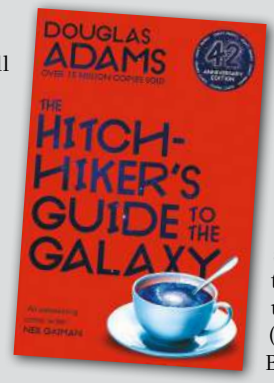
For various reasons, the police have recommended we improve our house security with a video doorbell. We experimented with a Ring model. As I don't use a smartphone, my son (who doesn't live with us) set it up using his Android phone, and I viewed the results on my Windows 10 PC.

For the 28-day trial period it worked perfectly, but when that

Star letter

The answer isn't 42

It was so sad to read Jon Honeyball having a philosophical chat with Grok 2 about the chicken and the road (*see issue 362, p111*). Jon is usually really good at pointing out the errors but he missed the glaring one in this response to his question. Particularly sad as X's owner Elon Musk is a fan of *H2G2*, and put a copy of the book in the glove box and Don't Panic on the dashboard of the Tesla roadster car he launched into space in 2018.



Grok 2's response included "Philosophical answer: The chicken, embodying the existential journey of all life forms, sought meaning on the other side, perhaps hoping to find the answer to life, the universe, and everything (which, as we know, is 42)." But typical of AI, that's wrong. 42 is not the answer to life, the universe and everything; it is the answer to "the ultimate question of life, the universe and everything". In fact, the Earth was a whole new planet that had to be created to find what the question was. **Jim Barton**

Contributing editor Jon Honeyball replies: I hang my head in shame, for you are indeed correct. I will send an email to dna@cix.co.uk to apologise (for those of us who were there at the time).

This month's star letter writer wins a Cherry KC 200 MX mechanical keyboard, worth £80, recipient of a five-star review and a *PC Pro* Recommended award. Email letters@pcpro.co.uk

ended and I subscribed to a plan I had problems. Most alerts stopped, and most of the time when motion was detected there was no video. Live view was perfect, so the problem was not with the Wi-Fi. After an hour-long phone call to support we were advised that Ring apps don't work on any device that has a VPN installed and that we should deactivate all our antivirus defences. No! No! No! None of which threw any light on why the trial was successful but the subscribed plan service was not.

Are there any video doorbells that will link to the PC via Wi-Fi and can be set up and controlled by the PC as master without requiring a smartphone for installation?
Meic Goodyear

News & features editor Barry Collins replies: Unreliability and a steep rise in subscription fees eventually forced me to part ways with Ring. I don't know of any video doorbell that works exclusively with a PC, but I do know that Ring (and others) are compatible with Home Assistant, which is great for getting a live view of your cameras and setting up automations that can deter burglars by switching on security lights when someone comes into view, for example.

Windows compatibility

I feel I should share some recent problems I've had. My Windows 23H2 was misbehaving and wouldn't update to 24H2, so I did a clean install of 24H2. The PC immediately started randomly rebooting to BSOD every few minutes, sometimes even before I'd logged into Windows, and the BSOD message kept changing.

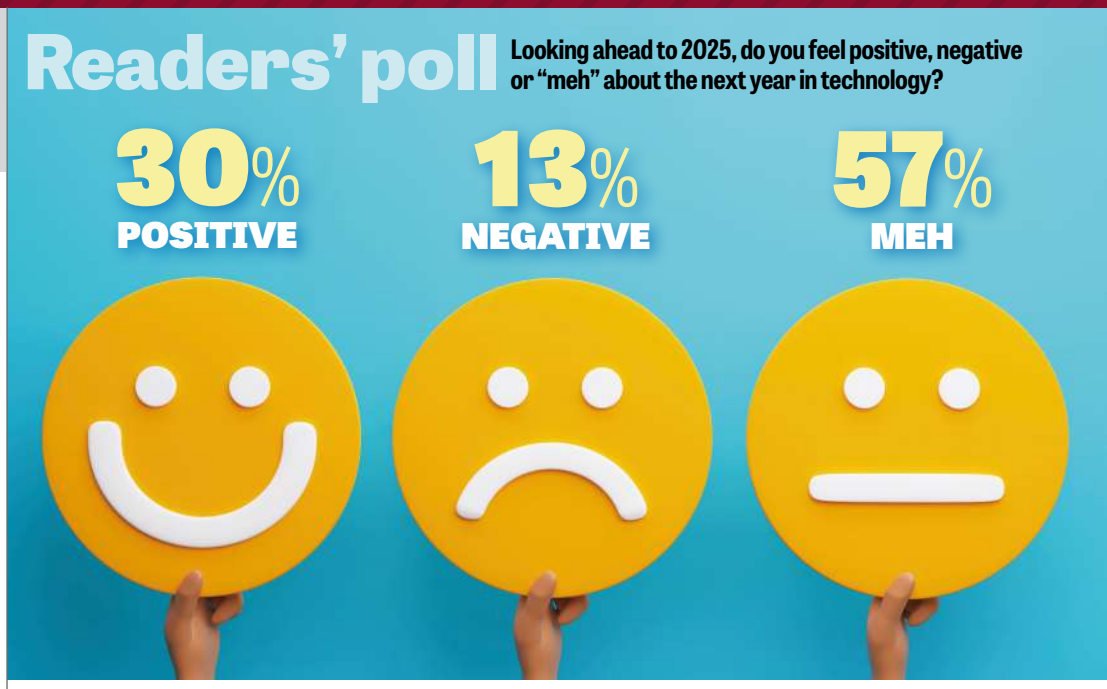
After two frustrating days trying to cure it, I searched the internet and found that there was a compatibility problem with five different Western Digital SSDs, but my WD SA510 Blue wasn't listed as a problem drive. Instead, the problem was to do with memory allocation – HMB – being limited to 64MB in 23H2, but could go up to 200MB in 24H2, causing a crash.

A Registry mod was available either to limit it to 64MB or to disable it. I tried the first option and it still rebooted, albeit less frequently, so I then disabled it and the system has now remained stable for two days, so I'm hoping the problem is cured.

I have no idea if system performance is affected but I think your readers should be aware of this.
Francis Norton

Readers' poll

Looking ahead to 2025, do you feel positive, negative or "meh" about the next year in technology?



Let's be positive ourselves: more people are feeling positive than negative! Among them, Tom Dickson. "The imminent death of Google as we replace keyword search with AI will be a huge shake-up, and those advertising dollars will land on many unexpected, exciting new technologies," he said. "We're in for a fun time, and I don't just mean snazzy mechanical keyboards."

Graham Steel agreed. "I expect AI to slowly mature, become more helpful, making it quicker and easier to get answers and for users to produce relevant artefacts and materials."

In fact, AI appeared in over half of people's comments. Roughly speaking, feelings on the subject reflected our overall vote, with Gareth Evans arguing that it's becoming "another tool of repression in the despot's armoury and not doing anything to free up work time for employees".

Lincolnshire Rebel, @LNSRBL23 on X, felt that "tech these days [is] just more of the same with different wrapping. We should only buy what we need, and the industry isn't providing any new 'need'."

Clearly LR hasn't been persuaded by the Vision Pro, but Peter Jones is more optimistic. "On a micro scale, [I'm] positive. Jon has successfully sold Apple Vision to us and AI seems to be becoming genuinely useful. On a macro scale, negative. Elon Musk and Donald Trump's co-operation along with the role of technology in wars makes me wonder if we are headed to a technological dystopia. *Neuromancer* here we come."

Representing our "meh" majority, Mike (@Webbo_73 on X). "Pretty meh about hardware but AI looks to be getting exciting and scary in equal measure. As long as we don't end up in a *Terminator*-esque future, it's likely to be developing at unprecedented speeds, which is fascinating for technologists."

"I'm still getting over the fact MS wants me to junk a perfectly working PC as it does not meet the W11 criteria." @hobson1999

"Negative – mainly due to end of Win10 support (laptop spec does not support Win11)." Charles Dytham

"Most things these days are incremental upgrades. The revolutionary upgrades of the 80s and 90s are gone." Si Mellor

"A bit meh... there may be a huge jump on the horizon (battery technology?) but not yet." Gordon Jackson

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GIFTS FOR GEEKS 2024

IN OUR ANNUAL ROUNDUP OF GIFT IDEAS FOR PEOPLE IMPOSSIBLE TO BUY FOR, WE COVER EVERYTHING FROM CHESS SETS TO PORTABLE BLUETOOTH TURNTABLES

If you're at all like us, when someone asks you for gift ideas you shrug your shoulders. "Dunno." Which isn't very helpful, so how grateful you must feel right now to discover that you can have the pick from 36 hand-picked products. And, with two exceptions, these products have all been put to the test by *PC Pro* or the extended network of Future tech websites. That means you can buy with confidence, as we've only included products that we would be happy to receive ourselves (hint).

We decided against including products that you'll find on our A List. If you're after a stylish laptop, blazingly quick desktop PC or pro-quality monitor, then those pages have you covered (*see p14*). Nor will you find any tablets here, as we have a group test of the best from p76, and also include a review of the late-arriving iPad mini on p68.

Instead, our focus on these pages is on fun. How about a travel-friendly record player to give your vinyl an airing? Or perhaps one of the two games consoles we cover will set your credit card tingling – we've steered away from the brilliant yet boring Nintendo Switch and focused on a portable gaming PC and retro console instead. Gamers might just be taken by the £600 Razer chair we review as well.

There's plenty more here. Two virtual reality – sorry, immersive reality – headsets, a comedic pair of earbuds, the latest e-readers from Amazon and Boox, plus four (real) books that any geek would be delighted to unwrap of a festive morning. And we have our equivalent of socks, too, whether that's the Swiss Army knife of USB cable connectors or a backpack that's as practical as it is stylish.

And if you scroll to the very end of this feature, you'll discover the hottest hardware of the year, as decided by listeners to the *PC Pro* podcast over the course of 2024. With options covering a 20TB enterprise hard disk, a £3,499 telescope and (of course) a keyboard, there really is something for everyone.

CONTRIBUTORS: Barry Collins, Tim Danton and Josephine Watson, with contributions from Tom Bedford, Philip Berne, Alistair Charlton, Matt Evans, Ural Garrett, Hamish Hector, Sam Kieldsen, Harry Padoan, Becky Scarrott, Les Watson and Dashiell Wood

All prices include VAT and are correct at time of going to press

DJI AIR 3S

BASE KIT, £959 FROM STORE.DJI.COM

This is the flagship model in DJI's Air range, and comes with a two-camera setup: instead of a single camera for aerial photos and video, a module pairs wide-angle and medium-telephoto cameras, mounted on a three-axis gimbal on the drone's nose. Both cameras are excellent, and can shoot 10-bit 4K video at 60fps (120fps in slow-motion mode), while a new, larger sensor on the wide-angle camera gives it a distinct advantage over the Air 3 in lower-light conditions. Add LiDAR sensors and it's also better at avoiding collisions whatever the conditions, while DJI's array of tools make it easy to operate (including automatic take-off and landing and advanced return-to-home tech). A battery life of up to 45 minutes is yet another plus. The bad news: its weight means you have to complete a paid competency course and pass an exam to fly it in any public space or built-up area.

LENOVO THINKVISION M14T GEN 2

£290 FROM LENOVO.COM

The M14t Gen 2 retains the sleek, all-black design of its predecessor, featuring a 14in IPS touchscreen that can easily switch between vertical and horizontal orientations. However, this new model offers several upgrades, including a higher 1440p resolution and a significantly enhanced contrast ratio of 1,500:1. Whether you're watching videos, editing photos or typing in a spreadsheet, it looks great – and it now covers 100% of the sRGB gamut so colours look far bolder than the first M14T (and most portable monitors). And because Lenovo is generous enough to bundle a stylus, it's great for doodling, annotations or adding your signature. We wouldn't recommend it to gamers due to the 60Hz refresh rate, but a peak 300cd/m² brightness is plenty for whipping out in a hotel room or café.

ULTIMATE EARS MINIROLL

£70 FROM AMAZON.CO.UK

Who doesn't love a Miniroll at a Christmas party? Except this isn't the Cadbury's chocolate sponge but a dinky portable speaker that's apparently designed for parties. The good news if you're thinking about this for the kids is that the volume doesn't blast too loud – think more intimate gathering or picnic than party speaker. But the sound offers loads of bass for its size, and you can get up to 12 hours of playback from a single charge. The included carry strap makes it easy to attach to bags or wrap around a child's wrist, too. It's obviously not the last word in audio quality, but kids will love a speaker they can easily slip in a rucksack for the trip to the grandparents, and it's IP67-rated waterproof, meaning you don't need to worry about drinks leaking in the bag.

LENOVO LEGION GO

£700 FROM ARGOS.CO.UK

The Steam Deck OLED is still our favourite pure gaming handheld, but if you want a gaming portable with the flexibility to double as a workaday PC too, the Legion Go is the one. The design ticks a lot of boxes: detachable controllers that can be replaced if they break; a Surface-like kickstand that's perfect for smashing through Netflix series while you travel; and a trackpad on the right controller for navigating Windows 11's fiddly menus without having to rely on touch alone. Gaming wise, it excels with streaming services such as Xbox Game Pass and GeForce Now, but of course games can be installed locally too, although there's only 512GB to play with. Battery life is poor, too, so keep the charger or a power bank to hand. Bear in mind a version 2 is in the works, so there should be better to come.

KRAFTED CONNEX

£30 FROM KRAFTEDTECH.COM

Built like a Swiss-Army knife, but without an implement to get stones out of horse's hooves, this device helps overcome the frustrations of not having the right charging cable with you. With both USB-A and USB-C inputs, and micro-USB, Lightning and USB-C outputs, it covers a multitude of old and new devices. There are frustrations: the short charger connectors can make it difficult to plug-in devices, especially if a port is recessed or, say, high up on a car dashboard. Charging throughput is limited to 25W and data transfer rates aren't great, either. But it's the kind of device you could shove in a laptop bag to get you out of the odd charging emergency.

MIXX REVIVAL 55 VINYL RECORD PLAYER

£79 FROM MIXX-AUDIO.COM

Late to the vinyl renaissance? The MIXX Revival 55 offers an easy way to jump on board, and an excuse to dig out all those dusty discs from your loft, and it looks pretty darn funky too. In classic Dansette style, it's extremely portable – it's easy to carry thanks to a built-in handle and chunky briefcase-like housing – and there's no shortage of ways to listen. You can pump tunes out of the surprisingly respectable speakers, plug in a pair of wired headphones, connect up to your hi-fi via the RCA jacks on the rear or connect to a Bluetooth source. Which is exactly what we're doing as we write this; we're not embarrassed to say that Village People's "I'm a Cruiser" is feeding the good vibes to our Bluetooth headphones as we type. You can also use Bluetooth to send tracks to the Revival 55. Available in three different colours, this could be a surprise hit in the Christmas present charts.

META QUEST 3S

£290 FROM META.COM

If you don't fancy paying £470 for the Quest 3, the 3S is a great alternative. It uses the same Snapdragon XR2 Gen 2 chipset as the Quest 3 so is just as fast, but the base model only includes 128GB of storage and it's a little bulkier; we wouldn't want to wear the Quest 3S for any longer than the two hours its battery lasts. The bulk is partly due to the use of lesser lenses, leading to a narrower field of view, but a 1,832 x 1,920 resolution per eye and 120Hz refresh rate means games still look amazing.

EVERCADE EXP-R

£100 FROM EVERCADE.CO.UK

The Evercade EXP-R is a risky choice as we haven't had a chance to play with it yet, but if you read our profile of Evercade and its retro consoles (*see issue 362, p123*) then you'll know why we have confidence in this UK company's products. Here, it updates its popular Evercade EXP handheld with a slimmed-down version (there's no mini-HDMI port) that comes with the first three *Tomb Raider* games. It includes a 4.3in screen, built-in controls and Wi-Fi. As before, you can expand the supplied collection with cartridges – it's fully compatible with the EXP – and relive classic titles such as *Duke Nukem*, *Worms* and *Xenon 2*.

AMAZON ECHO HUB

£170 FROM AMAZON.CO.UK

The Echo Hub isn't designed to be a speaker: instead, it wants to be the control hub for your ecosystem of Amazon smart home products. It also supports Matter, Thread and Zigbee, while power-over-Ethernet and USB-C give it flexibility. Although it can sit on a stand, it's best when hanging on a wall. The key to it all is an 8in touchscreen that you can use to view live feeds (up to four) from cameras, or tap on icons to control smart lights, heating and smart plugs. There's a mic for voice control, too, though you can switch this off if you want privacy from our Amazon overlords. The OS is clunky in places, and the price high for what you get, but it's a great way to take back control of a sprawling smart home.

WACOM MOVINK 13

£729 FROM WACOM.COM

Wacom's drawing tablet is a wonderfully slender device. The 16:9 OLED screen has a Full HD resolution and a drawing area of 11.6 x 6.5in, giving digital artists plenty of space to work with, without inducing arm ache as the device weighs only 420g. It connects to a PC/Mac with a 1m USB-C cable and comes with a tailor-made version of the Wacom Pro Pen 3. This stylus is fully customisable, meaning you can choose the thickness of the grip, adjust its balance, and add or remove side switches. The drawing experience is great, too, with the surface providing the perfect level of bite to replicate that pen-to-paper feeling. It might not have the resolution for pros, but it's an affordable entry point for those who like to dabble with digital drawing.

MOUS DAY BACKPACK

£130 FROM UK.MOUS.CO

The Mous Day Backpack is the brand's latest addition to its newest line of products – tech-first backpacks – and it's a fantastic option for commuters who also want a bag that's both relatively rugged and stylish. Available in a selection of muted, pastel colours (blue, stone, sage and black), its 20-litre capacity includes nine compartments – the six internal ones, which include a 380 x 285mm sleeve that will house most laptops, can be easily accessed by a zip that slides downwards to make access easy. It's also water-resistant and uses recycled nylon.

GARMIN DASH CAM MINI 3

£150 FROM GARMIN.COM

The Mini 3 is the market leader when it comes to discreet dash cams. This tiny unit shoots Full HD with HDR at 30fps, and is so small it practically disappears behind your rear-view mirror, for a near-seamless installation. It also has a decent voice control system, and the smartphone app works well for adjusting settings and downloading stored footage. Footage is sharp and clear, with nicely balanced exposure and enough detail for easily reading vehicle number plates, street signs and road markings; all the things you rely on a dashcam to pick up with great clarity. Aside from a new polarising lens, there's not much incentive to upgrade if you've owned a previous Mini, and don't forget to budget for a microSD card to bundle with this gift, as there's no storage included.

GOCHESS MINI

£200 FROM VERY.CO.UK

The "Mini" makes this sound like it's a travel set, but it has the same 35 x 35mm squares of a typical chessboard. What sets it apart from those, and everyday chess computers, is that it connects to Lichess and Chess.com so you can play anyone in the world – the squares light up to show you what to move. (Sadly, the pieces don't move themselves.) You can also train yourself using the built-in AI tutor, play games against the AI or simply play someone over the board. It isn't cheap at £200, but the pieces have a satisfying heft, and the whole set remains portable enough to take anywhere.

SAMSUNG BESPOKE JET BOT COMBO AI

£1,299 FROM SAMSUNG.COM

Yes, AI has come to robot vacuum cleaners. Thank goodness they can't climb stairs or we'd all be doomed. In this case, the AI recognises obstacles and adjusts its power levels to the floor type it detects, but more handily for fans of Samsung's SmartThings it fits neatly into this smart home ecosystem (for laughs, it includes Bixby voice commands, too). The Jet Bot Combo also vacuums carpets, mops hard floors (great for spills), grinds any pet hair so it doesn't clutter the brushes and can empty its bin when it gets back to base. But then you'd expect nothing less at this price.

BOOKS FOR GEEKS

OUR PICK OF FICTION AND NON-FICTION THAT MAY JUST BE OF INTEREST TO *PC PRO* READERS AND THEIR FELLOW TECH LOVERS

HELLSANS BY EVER DUNDAS

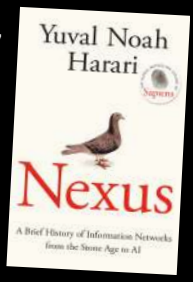
£4.50 FROM AMAZON.CO.UK

A dystopian sci-fi thriller about a font sounds like a tough read, but it's actually the premise of a magnificent novel by Scottish author Ever Dundas. HellSans is the font used by the authoritarian government in all public spaces. It triggers a blissed-out feeling in most citizens, but a minority are allergic to it, forcing them to live in the neglected edges of society in the ghettos. One of these so-called HSAs (HellSans allergic) is Jane Ward, CEO of a company that makes the Inex, a doll-like AI cyborg that everyone owns. The story centres on Ward and Dr Icho Smith, a scientist who's developed a cure for the allergy, who attempt to bring down the government and cure the HSAs. Split into three parts, the first two parts can be read in any order: one from Ward's viewpoint, the other from Smith's. It's clever, dark and a grim portent of where relying on AI assistants could lead us.

NEXUS BY YUVAL NOAH HARARI

£19 FROM AMAZON.CO.UK

This is a thought-provoking book, which should come as no surprise as it's written by the author of the brilliant *Sapiens*. Here, Yuval Noah Harari explores humans' need for networks, tracing their evolution from the earliest civilisations to their role in the rise of Nazism to the rise of "fake news" and unbelief that dominate so many of our social networks today.



Rather than a technological viewpoint, he frames it philosophically, challenging the notion that truth will win out if we keep adding data and information. And he goes one step further, asking whether artificial intelligence could alter the whole idea of what "reality" is – could AI form the nexus (or central hub) of the book's title that determines what is lie and what is truth?

THE LONG HISTORY OF THE FUTURE BY NICOLE KOBIE

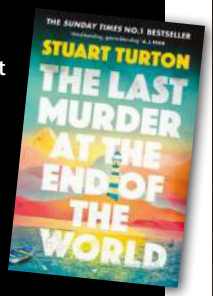
£13.85 FROM AMAZON.CO.UK

When she's not producing *PC Pro*'s Futures section, Nicole Kobie is writing books. In this case, an exploration of why so many promising technologies – from driverless cars to robots, from smart cities to augmented reality – always seem to be just around the corner and never quite arrive. Thanks to her historical overview, drawing on in-depth interviews with scientists, engineers and academics, by the end of the book you'll have a much better idea, too. Just don't expect a robot butler any time soon.

THE LAST MURDER AT THE END OF THE WORLD BY STUART TURTON

£15 FROM AMAZON.CO.UK

Former *PC Pro* writer Stuart Turton sold over a million copies of his first novel, *The Seven Deaths of Evelyn Hardcastle*, but we think his latest is also his best yet. And, for reasons we won't go into, the most appealing to geeks. Here, murder is again in the air, as is a mysterious fog that surrounds an island – where the last three survivors of the human race are kept company by "villagers" who can talk to a God-like being as they go about their tasks. They wake up one morning to discover one of the humans dead, but who killed them? None of the villagers knows, as their memories from the previous night have been wiped, but it falls to one of them to discover who done it – and why.



AMAZON KINDLE COLORSOFT

£270 FROM AMAZON.CO.UK

A mere 17 years after the first Kindle, Amazon has added colour to its e-reader. This despite the fact that rival Onyx has offered it since 2021. For those with a big library of Kindle books, though, it's a great chance to finally enjoy graphic novels and comics in colour. So far we've only spent a limited time with the device, but the 7in display is superb (although we have seen complaints of a yellow cast from online reviews) and genuinely paper-like, while Amazon has kept the compact design of previous Kindles. It's expensive, sure, but you get nippy performance and battery life of up to eight weeks.

ONYX BOOX PALMA

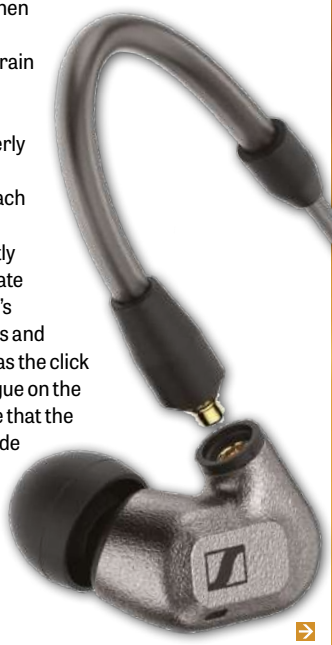
£230 FROM EUROSHOP.BOOX.COM

The Boox Palma has been one of the sleeper hits of 2024, a phone-sized e-reader with an E Ink display that's perfectly suited for reading on the go .The 6.3in device runs on Android, although it won't make calls or access mobile data. It does, however, have full access to the Play Store, meaning you're not locked to the Kindle Store for books as you are on Amazon's own devices. It's remarkably lightweight too. If you're someone who regularly reads on your phone only to suffer from eye fatigue, then the Palma is an easy switch to make, albeit at a price. Also note that the Boox Palma 2 with a punchier processor and support for a more modern version of Android has just been announced.

SENNHEISER IE 600

£479 FROM AMAZON.CO.UK

If you're hoping for a touch of audio luxury under the tree this year, you won't want to look much further than the Sennheiser IE 600. This in-ear set paints the most delicate details onto a canvas. They excel in tying several sonic elements together into a beautiful work of art, with exceptionally clear and beautifully balanced audio, plus strong separation, too. When listening to "Rains Again" by Solji, the rain coming down throughout the introduction is utterly natural and convincing, with each drop defined. The earphones perfectly captured the delicate nature of the track's high-pitched vocals and finer details, such as the click of the singer's tongue on the palate. It's a shame that the cable doesn't include an in-line controller or mic, but it's the only complaint we have with these top-quality wired headphones.



OURA RING 4

£349 FROM OURARING.COM

Despite Samsung's efforts, this is still the best smart ring on the market. It's as easy on the eyes as it is on the fingers, being supremely comfortable to wear at night thanks to the lack of protruding inner nodes. You also get a choice of six finishes, all composed of tough titanium. The battery lasts for around five days, during which time the Oura Ring will accurately track what you're doing – whether that's sleeping or one of 40 different workouts. You might need one of its mindfulness services to calm you after seeing the price, though, as £349 doesn't cover the subscription needed for advanced features – £70 for a year or £5.99 per month.

CAMBRIDGE AUDIO MELOMANIA M100

£149 FROM AMAZON.CO.UK

The Cambridge Audio Melomania M100 earbuds have a unique twist: comedy actor Matt Berry voices the device prompts, adding a delightful touch of eccentricity from this British audio firm. Don't think these headphones rely on that gimmick alone. The ANC here is as effective at cancelling low-level noise as you could wish for, cocooning the listener in a bubble of near-silence, even cancelling out the tapping of the keyboard as we write this review. The transparency profile is disappointing, mind, with a bit too much audible feedback and a near-constant quiet hiss. But this is a minor quibble with a pair of long-lasting (16 hours with ANC, 36 without) buds with great build quality.

NANOLEAF X FANTAQI EXPO

£300 FOR 4 PACK FROM NANOLEAF.ME

If you've got prized collection to show off – Lego models, a comic book collection, rare trainers – the Nanoleaf x Fantaqi cabinets will help you do just that. Each case measures 38 x 29 x 22cm (WDH), and to give you some idea of scale, a DVD case will stand perfectly inside, but will need to be inserted at a slight angle to get past the lip on the front of the box. Each case is electrically connected to the next one using the supplied linker strips that slot into holes midway along the sides of each case. It can be tricky to get the linker in the hole when coupling two cases, but it's a minor irritant. The buggy software that controls the smart lights is equally irritating, but when working as it should, it creates up to 300 linked and beautifully lit cases.

RAZER ISKUR V2

£600 FROM RAZER.COM

It's a well-kept secret that gaming chairs often also make excellent office chairs, especially when the design isn't too gaudy. That's certainly not a problem with the tasteful Razer Iskur V2, which has a standout feature for those who suffer from back pain. The chair has "6D" lumbar support, which basically means a back pillow that pivots as you twist in the seat. The height and strength of the lumbar support can also be adjusted with two easy-to-reach knobs, offering great comfort and support. Assembly is flawlessly smooth, too, going from box to ready to sit on within 20 minutes. The only slight irritation is the head pillow, which occasionally slipped from the chair.

LOGITECH MX CREATIVE CONSOLE

£200 FROM WWW.LOGITECH.COM

If you spend much of your time in Adobe's Creative Cloud apps, this two-part console could be a real timesaver. The first part is a Stream Deck-like keypad, with nine customisable buttons and two buttons to move from page to page, allowing you to program endless shortcuts. Except that you don't need to do any of the programming for the main Adobe apps as all the shortcuts are pre-prepared for you, meaning no more learning keyboard shortcuts or hunting through menus for commands you use regularly. The second part is a battery-operated dial, letting you adjust brush sizes, scroll through timelines and much more. The dial is definitely less useful than the keypad, especially if you've already got a decent mouse such as the MX Master 3S, but the combo is made more alluring by the included three-month subscription to Creative Cloud.

ELGATO STREAM DECK NEO

£100 FROM CURRYS.CO.UK

Despite our pestering, Elgato didn't send us a Stream Deck Neo to test – so, like the Evercade EXP-R, you buy this at your own risk. We still include it due to Elgato's strong history of building high-quality products and, well, it's so darn simple, what can go wrong? Similar to the Logitech MX Creative Console above but at half the price, you can customise the eight buttons to act as shortcuts during your work. Perhaps to replay macros, repeat routine sets of actions, or simply to paste your address into emails. Or it can work in, say, Zoom calls, to mute mics, switch on the camera or exit the meeting.

HOT HARDWARE OF 2024

At the end of every *PC Pro* podcast, one of our panellists sticks their head in the lion's mouth, nominating a device as their Hot Hardware of the Week. This is then put to a highly scientific poll of their fellow panellists and live listeners, who decide whether the nominated device is truly hot or not.

The *PC Pro* podcast listeners are a tough jury. Many a laptop, Wi-Fi router or keyboard has failed to meet their exacting standards. So, if a device appears in this list, you know it's not only impressed one of the *PC Pro* crew but one of the toughest crowds to please.

Here is every single device that has won the Hot Hardware accolade in 2024 that you might consider buying someone for Christmas. There were other winners from this year's 50+ podcasts, but only someone seeking divorce would leave a Passmark USB Power Delivery Tester or a copy of LibreOffice under the tree for a loved one. Not least because the latter is free. And not hardware either.

You can listen to the *PC Pro* podcast live every Thursday (except over Christmas) at 1pm from **pcpro.link/discord** or download the show from all the normal podcast outlets.

GOOGLE PIXEL 8A

FROM £499 FROM STORE.GOOGLE.COM

Nominated by Barry Collins on podcast 694

Barry doesn't see the point of spending a four-figure sum on flagship phones. He's been the podcast's mid-range maestro for the past few years and the Pixel 8a is his latest pocket-filler. He was tempted in by the sizeable trade-in value offered for old iPhones, giving him a 50%+ discount on the price you see above by handing over one of his daughter's old handsets. This nippy little phone has a decent array of cameras (albeit with next to no optical zoom), and benefits from all the AI smarts that Google is bringing to its handsets. Battery life isn't amazing, especially if you wander into a 5G area, but you should get through the day on a single charge.

UNISTELLAR ODYSSEY PRO

£3,499 FROM UNISTELLAR.COM

Nominated by Barry Collins on podcast 701

Trying to observe the night sky in built-up areas is a bit like trying to watch snooker on a black-and-white TV… unless you have an Odyssey Pro. This smart telescope not only automatically points itself at spectacular nebulae, galaxies and other objects in the night sky, it uses a series of stacked exposures to unveil images that wouldn't otherwise be visible in light-polluted areas. This premium version has an eyepiece that doesn't bring that much to the party, so you could save yourself a hefty sum by opting for the non-Pro version for £1,999. Yes, it's expensive either way, but this is a genuinely delightful bit of techie kit.

SEAGATE EXOS X20 20TB ENTERPRISE SATA HDD

£330 FROM SCAN.CO.UK

Nominated by Jon Honeyball on podcast 686

Not everything Jon brings into the studio is a Christmas cracker toy (*see opposite*), as evidenced by the Exos X20 hard disk. The first hard disk Jon ever bought was a 16MB SCSI drive that, adjusted for inflation, would cost around £1,900 today. So to get 20TB for just north of £300 seems as silly as the Millennium Falcon multitool. Jon pumped six of these into his Synology NAS to create an enormous 90TB archive endpoint, alongside a couple of Samsung SSDs. They're quick, they're reliable and they've got long five-year warranties on them.

KEYCHRON C3 PRO

£37 FROM KEYCHRON.UK

Nominated by Barry Collins on podcast 683

If Jon gets to bring the fun to Hot Hardware, Barry brings the keyboards. It is known. And there's not been a better keyboard bargain in 2024 than the Keychron C3 Pro. There are no thrills or fripperies here: it's a wired, mechanical keyboard that's equally at home on Windows or Mac. You can take your pick from red and brown switches, but that's it as far as options go. The black-and-red look is mandatory, although extra keycaps in the box let you swap out the red Esc, Enter and spacebar keys for black options. It's a heavy, solid, reliable workhorse that has remained on Barry's desk all year, despite keyboards costing almost ten times the price passing through.

APPLE VISION PRO

£3,499 FROM APPLE.COM

Nominated by Jon Honeyball on podcast 702

Every *PC Pro* reader should take up the offer to get a demonstration of this device in an Apple Store, Jon claims, because this is the future of computing. The first real spatial computing headset, according to Mr Honeyball, this is a groundbreaking device whether you're watching movies, walking around and manipulating 3D objects, or simply adding a few rows to an Excel spreadsheet by using the device as a virtual Mac screen. Not that everyone should rush out and buy one: it's a hugely expensive proof of concept to show what Apple's capable of. But if a generous benefactor decided to leave one under the tree, you probably wouldn't take it back.

FAIRPHONE FAIRBUDS XL

£219 FROM SHOP.FAIRPHONE.COM

Nominated by Lee Grant on podcast 676

Fairbuds XL is a stupid name for a pair of over-ear headphones that aren't earbuds at all, but that's the only stupid thing about them. They're amazingly comfy, not causing an iota of discomfort on two eight-hour train journeys. They've got two active noise-cancelling modes, more than good enough to eliminate the rumble of trains of tracks, although clever enough to let people speak to you if needs be. They have a claimed 30-hour battery life, but you can buy a spare battery for £17 and snap it in and out effortlessly. Cushions, headbands, cables, covers and speaker housings are also replaceable, and you have a two-year warranty in any case. Oh, and they make David Bowie sound great.

PHILIPS HUE LIGHTS

FROM £18 ON AMAZON.CO.UK

Nominated by Rois Ni Thuama on podcast 714

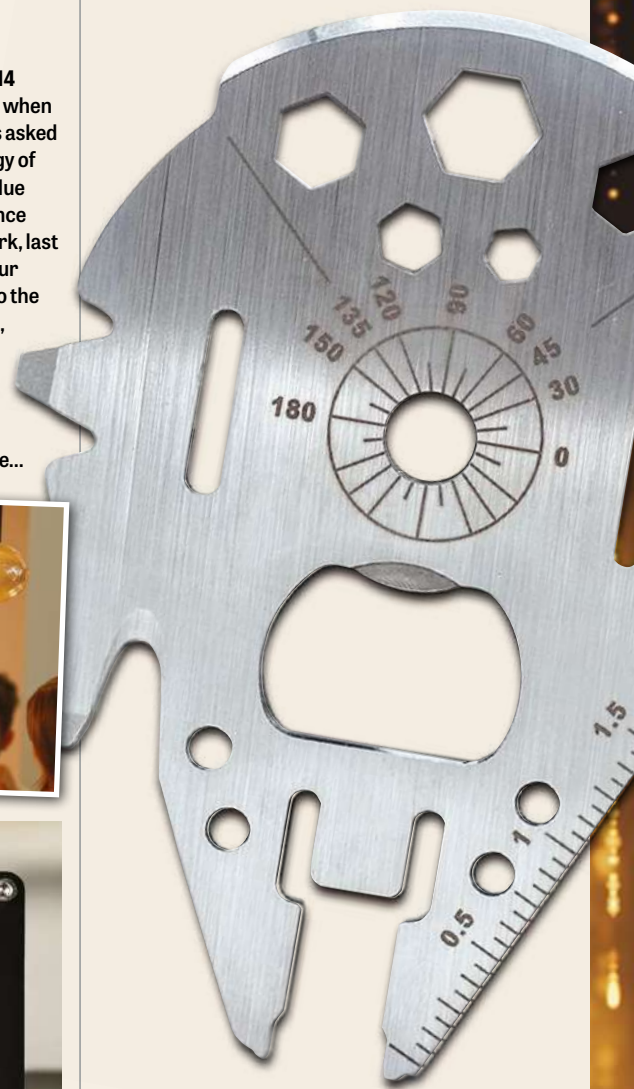
We're not quite sure how this happened, but when each panellist at the live *PC Pro* podcast was asked to nominate their most significant technology of the past 30 years, Rois plumped for Philips Hue lights. And, on the back of a well-oiled audience vote, won. They form their own mesh network, last 22,000 hours, and if you connect them to your Sonos speakers the lights can flash in time to the music to create your very own kitchen disco, Rois argued persuasively. And so, Philips Hue fought off competition from Wi-Fi, the Apple Vision Pro and the iPhone 3G to become the Hottest Hardware in *PC Pro* history. It's amazing this magazine is still alive...

GURGLEAPPS COLOR WIFI WORD CLOCK KIT

FROM £35 FROM GURGLEAPPS.COM

Nominated by Jon Honeyball on podcast 688

Yes, we're back to fun-time Jon. This is a joyful little display that gives you a rough approximation of the time, to the nearest five minutes, spelt out in words. It's all powered by a Raspberry Pi Pico, with a kit that you can either buy and assemble yourself (for £35) or have it delivered fully formed (£50). It's all been designed by a young family in the UK, with YouTube presentations on how to solder the thing together. Jon was absolutely knocked sideways by the tech-friendly family and their enthusiasm for making these geeky little toys and more.



STAR WARS MILLENNIUM FALCON MULTITOOL

£22 FROM AMAZON.CO.UK

Nominated by Jon Honeyball on podcast 682

Only Jon brings the truly fun things to the Hot Hardware table, and this one definitely falls into the stocking filler category. The multitool, shaped to look like Han Solo's reliable runaround, includes a wire cutter, flat-head and Phillips screwdrivers, a scraper, hex wrenches, a butterfly wrench and – most pertinently at this time of year – a bottle opener. You can clip it on a belt, but be wary of puncturing your car seat or impaling yourself if you do.

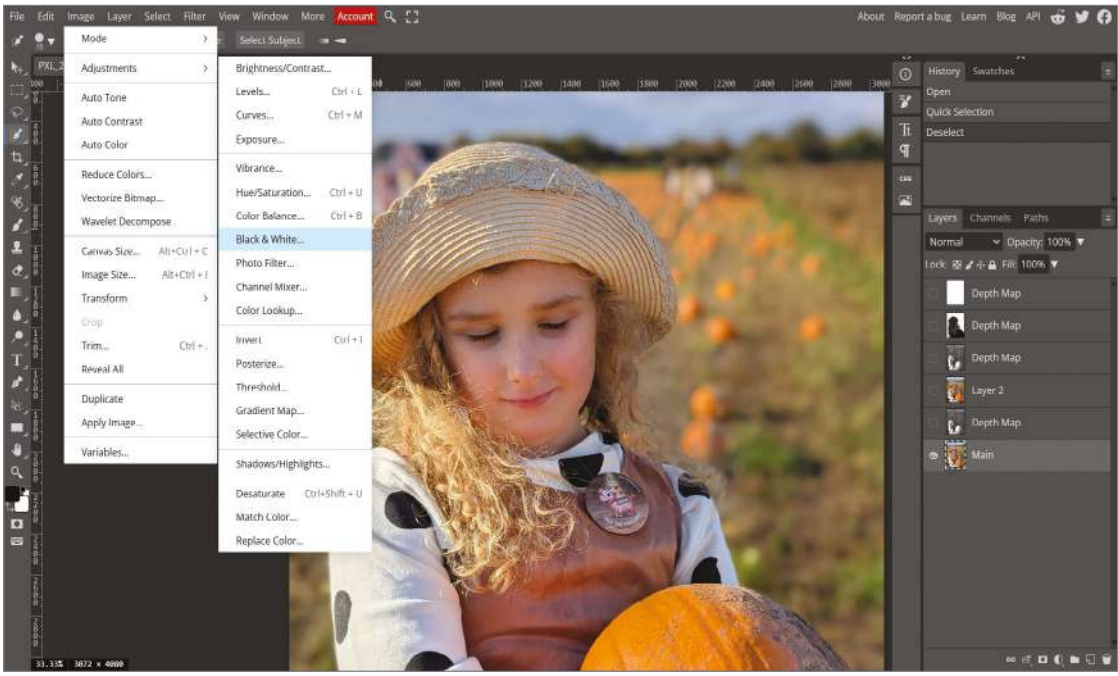
INSTANT EXPERT

PHOTOPEA

Touch up and transform images on any device, with nothing to install – Nik Rawlinson dives into the browser-based image editor

If you want to edit and enhance your photos, you don't need to install a weighty app – you can do it right in your web browser. One way is to use Adobe's online version of Photoshop (tinyurl.com/364photoshop), but this requires a full-price Photoshop subscription, making it uneconomical for casual use.

A great alternative is Photopea (photopea.com). This browser-based image editor offers a versatile, professional-grade editing environment with support for a wide range of file formats – and its interface will be immediately familiar to anyone who's used Photoshop or other serious image-editing software in the past. Best of all, if you don't mind seeing a few ads, you can use all its built-in features free of charge. Here's everything you need to know to make the most of this powerful online tool.



ABOVE The interface has much in common with a certain Adobe photo editor

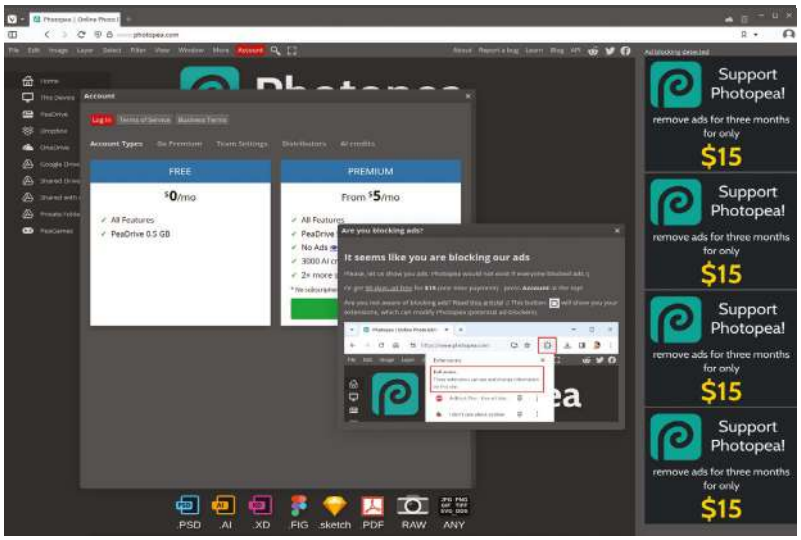
What does it cost?

Anyone can sign up to Photopea and start using it for free – you don't even need to create an account. The only catch is that a permanent ad panel will be displayed at the side of the browser window, reducing your available working space.

You can remove this panel by upgrading to a Premium subscription, which starts at $8 per month for a single user, $15 for 90 days, and $50 for a year. As well as removing adverts, a subscription comes with 3,000 credits per month for using the various generative AI tools that are built into Photopea, which we'll discuss below.

For businesses, Photopea offers team plans for five, 20 and 50 seats. These are priced on a sliding scale, so kitting out a team of 20 for the year costs $500, but for 50 it's only $999. Organisations can embed Photopea within their own domain, or even host it on their own server, to ensure it remains available should their connection to the outside world go down.

If that appeals, you'll need to talk to Photopea directly to get a price, and pay for 12 months up front. The fee includes two updates a year, with additional updates available for an extra $300 if you choose to implement them.



LEFT If you try to block Photopea's ads, you'll just see placeholders instead

PHOTOPEA USES INDUSTRY-STANDARD FILE FORMATS

1 May
The Acts of Union come into force
1707 England and Scotland had shared a monarch for more than a century by the time the Acts of Union officially brought them together to form a single kingdom. The Acts are so named because they were two separate treaties. The treaty enacted in England was the Union with Scotland Act, which was passed in 1706. In Scotland, it was the Union with England Act, which was passed in 1707.
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ABOVE Our InDesign file wasn't imported perfectly, but Photopea is still a powerful tool

How do I access Photopea?

Assuming you're not hosting it on your own network or server, you'll find Photopea at **photopea.com**. You don't need to download anything: the app runs entirely in your browser, and works on both desktop and mobile platforms. Slightly confusingly, you'll see a link on the welcome page inviting you to "Install Photopea", which installs a shortcut to allow quick access to the program in a mode with minimal browser furniture. This makes Photopea look and work more like a desktop application, but the editor itself still runs in the cloud. You can alternatively switch Photopea to full-screen mode by clicking the icon at the far right of the menu bar.

If you're worried about what Photopea's online model implies for data security and privacy, you needn't be. All the actual editing is performed on your own machine, using your own processor and GPU; unless you use the program's outsourced AI features, your images are never uploaded to Photopea's servers or anywhere else.

How does Photopea fit into my existing workflow?

Photopea uses industry-standard file formats, so you can work with your existing assets without having to convert and export them. This doesn't just mean JPEGs and PNGs: Photopea natively loads and saves in the PSD format as used by Adobe Photoshop, and can also read Illustrator, InDesign, Affinity Photo and Sketch files. It can open and edit raw camera files, too (including the platform-agnostic digital negative format), and even animations including MP4, WebM and animated GIFs.

Third-party files don't always import perfectly. We tried loading an InDesign file, and although Photopea got the layout right, with clearly labelled artboards, pages and layers, the copy didn't flow correctly from one frame to the next. Still, we were able to move elements about and extract the full text, which could be a very useful capability if you need to access a file and don't have the original Adobe application.

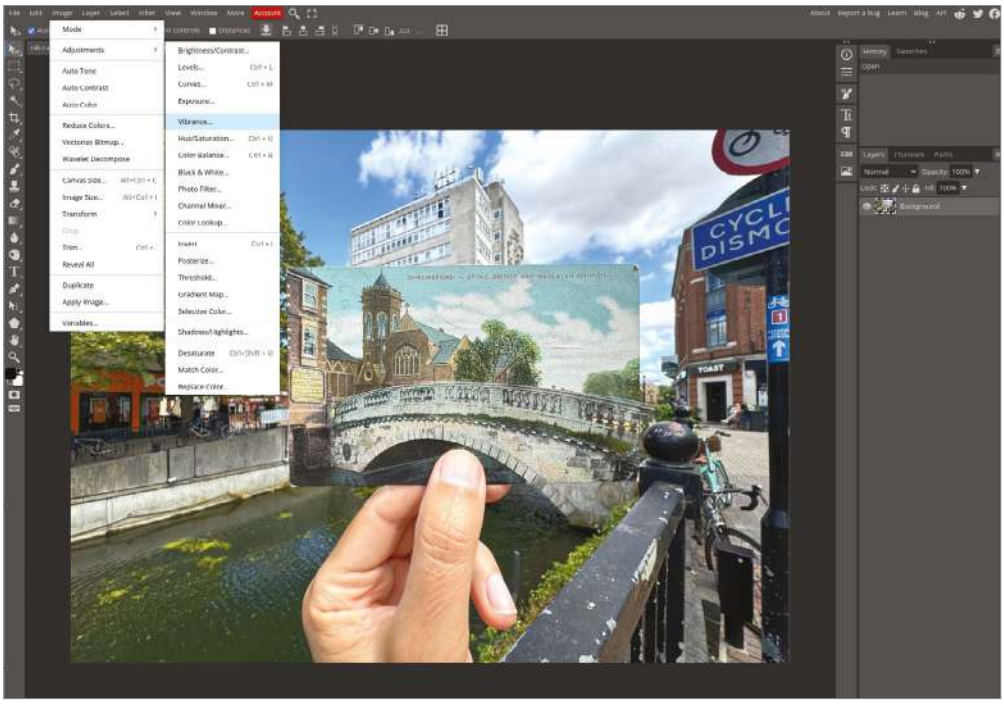
Connecting to cloud storage

As soon as the Photopea website appears in your browser you can start importing and editing files; free users don't even need to log in. However, when starting out you might want to link a cloud storage service to Photopea, for convenient access to your files. You'll find options for connecting to Dropbox, Google Drive and OneDrive in the sidebar, or you can use Photopea's own PeaDrive, which provides 500MB of storage for free users or 5GB for premium accounts. If you prefer not to use cloud storage, you can store your work locally by clicking "This Device" in the sidebar, or simply selecting "New Project" from the main part of the screen.

Existing images can be opened by dragging them into the application; dragging in an image when you already have a file open adds it on a new layer. Anything you import is automatically converted into PSD format for editing, including other file types such as InDesign layouts.

Make frame-wide adjustments

One common photo-editing task is to adjust the overall tone or colouring of an image. You can do this from the Adjustments fly-out on the



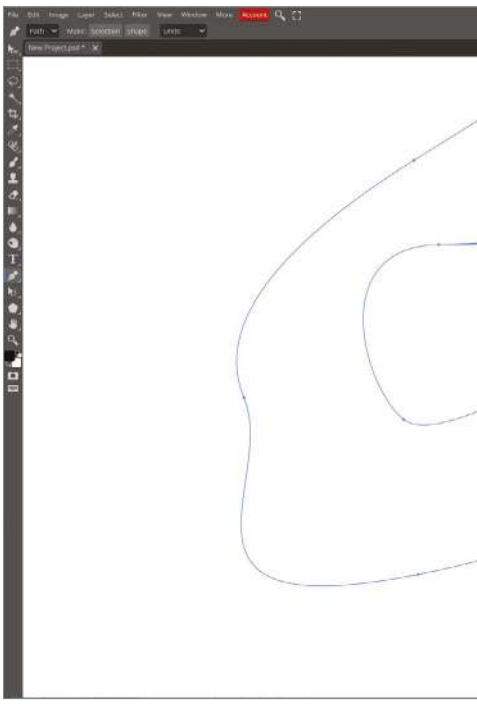


Image menu: here, you'll find all the editing tools you would expect, including curves, shadows and highlights, brightness/contrast and colour balance. There's also a powerful black-and-white adjustment tool, much like the one in Photoshop, which lets you rebalance the intensity of each channel within the original image.

If you want to tweak your edits later, or to apply them only to a certain part of the image, you can create adjustment layers by clicking the New Adjustment Layer button at the bottom of the Layers panel (it looks like a half-moon). An adjustment layer behaves like a lens through which you're viewing the visible layers below; it's ideal for non-destructively trying out different settings without modifying the original image. You can stack multiple adjustment layers and change their order, and adjust the opacity of individual layers to tone down effects that look too stark.

Most powerfully, all adjustment layers are created with a mask, which you can edit to make your adjustments apply only in specified areas of the image. Any area of the mask that you colour black (using Photopea's drawing or adjustment tools) will become transparent, meaning that part of the adjustment layer has no effect on the pixels below. You can also create areas of different opacities by painting in different shades of grey.

ABOVE Photopea's adjustment options let you change the tone of an image

ABOVE RIGHT The pen tool is particularly responsive

Focus on the details

Adjustment layers are great for broad corrections, but directly editing the content of an image requires a more hands-on approach. Photopea's toolbox will again be familiar to anyone switching from Photoshop, as will be many of the shortcuts for switching between its tools: press P for pen, B for brush, C for crop and so on.

These drawing and editing tools take effect in real-time. For example, if you're "painting" with the blur tool you'll instantly see the image soften as you stroke the layer. The same is true of the dodge and burn tools, which occupy the same toolbox button, along with the sponge tool. As is common across many image-editing suites, long-holding on a button opens the fly-out to reveal its alternative functions.

You can use all of these tools with a mouse, a touchpad, a touchscreen or a stylus; if your input device supports pressure detection, you can set Photopea to change either the opacity of your drawing or the brush size according to how hard you're pushing down. We tried this on an iPad with an Apple Pencil and found it a very natural and intuitive way to work.

Work with vectors

Photographs are, by nature, raster images, but Photopea also lets you add vector objects and layers to your file. The Shape tool in the toolbox can be used to create common shapes such as stars, polygons and arrows; if you want something more complex, the pen tool lets you design your own shapes using a closed loop of Bézier curves. Photopea is terrifically responsive when working with the pen tool in this way, and lets you quickly and intuitively refine your shape by grabbing and repositioning its handles.

Manage your layers

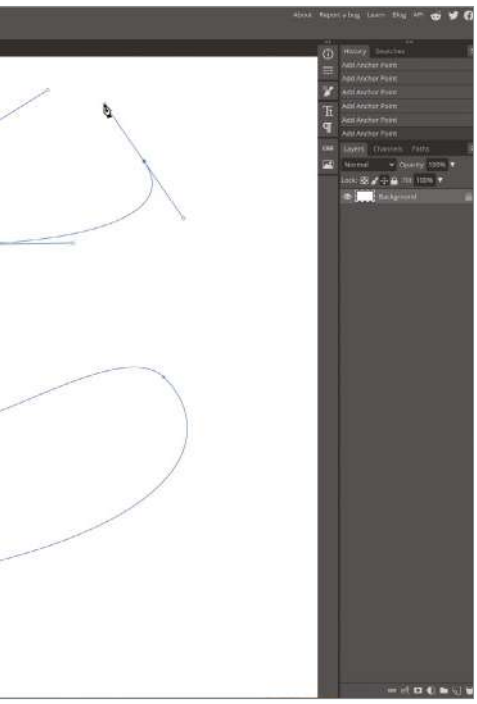
Layers aren't just for adjustments, or for separating raster and vector objects. They can be a powerful productivity feature, allowing you to separate and stack the different elements of your image, so you can individually transform and edit them.

If you're working with a flat image, there are tools on hand to help you move elements onto different layers: the Select | Subject tool automatically selects foreground objects, which you can copy and paste onto a new layer.

API AND SCRIPTING

Alongside its extensive in-browser editing capabilities, Photopea offers a powerful API for remote access and configuration. You can configure its settings and environment variables from a browser or a script simply by accessing the main URL, followed by a hash symbol and a valid stream of data in JSON format – see **photopea.com/api** for more about what you can do.

What's more, almost every feature of Photopea can be remotely accessed and controlled in JavaScript, again passed via the web API. This allows you to use Photopea as the basis for your own batch-editing or processing routine. API access is free and unlimited, even if you're not a subscriber, and since the syntax is almost identical to that of Adobe's scripting interface for Photoshop, you can use imported scripts with little or no modification required. See **photopea.com/learn/scripts** for a guide to how it works.

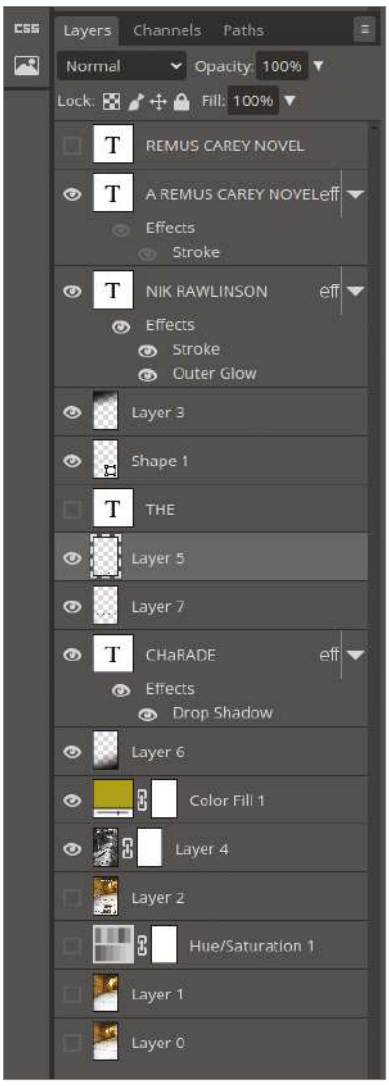


The AI-powered Select | Remove BG does the opposite, automatically removing the background from a layer (see "AI in Photopea", right).

If these tools don't get it quite right, you can use the Magic Cut feature to manually highlight which parts of the image you want to include and exclude, with a live preview that lets you refine the selection until it's perfect.

Working with layers doesn't have to mean continually flipping up and down through the stack. At the bottom of the Layers palette, you'll find a set of controls that allow you to group layers or place them into folders. This allows you to easily adjust settings such as opacity and blend modes for multiple elements at once – or show and hide them all together. There's also a button for applying visual styles to one or multiple layers, with options including outlines, drop shadows and more.

Perhaps the most powerful layer style is the one that controls blending, with options for blend mode, opacity and fill. Through this style you can access the "Blend if" control, which sets the current layer – or aspects of the current layer – to be visible or hidden depending on the intensity of its own red, green, blue or grey levels, or those of the background layer.



Save and share your work

Whether you're using Photopea to edit existing images or to create something original, you'll eventually want to save your work. We've mentioned that Photopea uses PSD as its native file format, so this is the best choice for ongoing projects. If you want to share your work or upload it to social media, you can export flat files in JPEG or PNG format – or, if it's a vector image, you can save it as a SVG or PDF file.

By default, Photopea saves files to your local hard disk, but selecting "PSD to Storage" will open a more extensive in-app file-saving dialog, with direct access to Dropbox, Google Drive, OneDrive and PeaDrive. If you want to use one of these services but didn't grant access to Photopea when you first started using the suite, you can authorise it at this point.

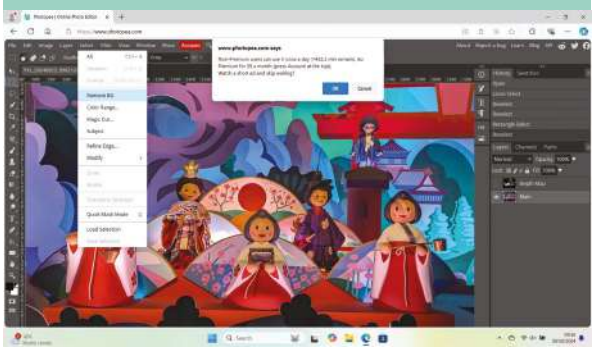
Since Photopea doesn't lock you into any proprietary workflow or file format, you've nothing to lose by trying it out as an alternative to a costly Photoshop subscription. In fact, even if you already use Photoshop, Photopea's ability to open and save PSD files makes it a convenient companion app for trying out ideas or making quick changes when you're away from your main computer. It can also be a cost-effective tool for a business, giving employees who don't require a full offline editing setup an easy way to collaborate with colleagues using Creative Cloud or other design tools. ●

AI IN PHOTOPEA

You might be fed up of hearing about AI, but image editing is an area where it can be enormously helpful. We've mentioned the AI-assisted Remove BG tool, which does a spookily intelligent job of separating foreground and background objects; Photopea also uses generative AI for its Magic Replace tool, which can transform and add new elements to an image based on your text prompt.

Unfortunately, as we all know, AI is expensive to operate, so free users are only allowed to use Remove BG once per day without interruption. If you want to use it again within 24 hours you have to watch a short video advertisement first, while Magic Replace requires watching two ads in a row. It's a distraction, but the ads aren't too intrusive (we've found they're generally between five and 20 seconds long) and the results are very good.

Premium subscribers won't normally have to worry about ads: they get 3,000 credits a month, with each use of Remove BG costing one credit and Magic Replace costing three credits. If you run out of credits you can create and link your own account at Dezgo (the back-end platform that powers Photopea's AI features), and pay as you go for as many operations as you like. Just be aware that these AI features require your image to be shared with Dezgo, meaning they're not as perfectly private as the rest of Photopea.



ABOVE LEFT
Layers let you keep your work organised and apply adjustments

YOU'VE NOTHING TO LOSE BY TRYING IT OUT AS AN ALTERNATIVE TO PHOTOSHOP

UPGRADE TO BUSINESS-CLASS WI-FI

A HOME OFFICE DESERVES A PROFESSIONAL NETWORK. DARIEN GRAHAM-SMITH MAKES THE SWITCH

Whether you're self-employed or simply blessed with an enlightened employer, many of us work at least partly from home. But is your home network up to professional standards? Most businesses run on specialist professional hardware, and there's no reason why you can't do the same. This month I tried moving my own home office onto a business-grade network, to see whether it's worth the investment.

At first this might seem like a big step into the unknown. There probably won't be a drop-in "business class" replacement for whatever home router you're currently using, so you'll need to do some research – which might include familiar consumer brands such as Asus, TP-Link and Netgear, and some that are better known in the enterprise world, such as Cisco and Ubiquiti.

If you're expecting your network to grow over time, your initial choice of vendor could have long-lasting implications. Most professional routers use a unified management platform that integrates with any wireless access points, switches or gateways that you may add in future, so it's important to think about the whole ecosystem you're buying into.

For a home office, though, you're unlikely to be investing in large numbers of companion appliances, so it's less of a concern. And for this – what we might call the micro-business end of the market – two brands that particularly stand out are DrayTek and Zyxel. In my case I went with the Zyxel AX6000 Wi-Fi 6 Security Router, an affordable little box that's tailor-made for small home offices. Here's how it went, and what I learnt.

PRO WI-FI IS CHEAPER THAN I EXPECTED

When I think of professional networking gear, I picture expensive gateways, switches and wireless access points costing thousands of pounds. To be honest, that's a big part of what's put me off making the investment for all these years. So the Zyxel system was a revelation: the AX6000

RIGHT DrayTek routers are a popular home office choice

Security Router (technically known as the USG LITE 60AX) is a compact, rather tasteful little box, made of 95% recycled plastics and costing only £142 exc VAT (**tinyurl.com/364zyxel**). It's cheaper and frankly more cheerful than most consumer routers I've seen.

Even better – as the name implies – it comes with Wi-Fi 6 built in. I had assumed I'd need to wire up separate access points, as this is how it's normally done with enterprise routers, but this little marvel has its own internal transmitter and antennae. Admittedly it's limited to Wi-Fi 6, but if you want to move up to a newer wireless standard you can add one of Zyxel's Wi-Fi 7 APs, or attach a third-party Wi-Fi 7 router, switch it into Bridge mode and use it as an unmanaged access point.

As well as being decently equipped for wireless networking, the router supports 2.5GbE Ethernet, for both WAN and LAN connections – not something you can take for granted at this price. Things are limited by the fact that there's only one 2.5GbE LAN socket, but you could hang a 2.5GbE switch

off this, allowing a group of wired devices to talk to each other at multi-gigabit speeds.

My only real gripe with the router's design is the way it stands upright, which caused it to easily topple over if I accidentally yanked on an Ethernet cable. This was resolved when a helpful chap from Zyxel pointed out that the base rotates outward to create a much more stable cross-shaped footprint.

ALL ABOUT THE CLOUD

Another reason I've been avoiding professional Wi-Fi is the idea of having to deal with cloud management. Don't get me wrong, this is clearly a great idea for IT departments with fleets of diverse networking devices spread across locations, but for a simple home-office network it seemed like an unnecessary complication.

I'm going to say that that instinct was half-right. Getting set up on Zyxel's Nebula management platform was a lot easier than I'd anticipated, since you can use your Google or Apple ID to blast through the registration process in two clicks. Then, though, you're required to specify both an organisation and an individual site for the new router – things that don't make a lot of sense at this scale, and just complicate the question of what's connected to what (I entered "home office" for both).

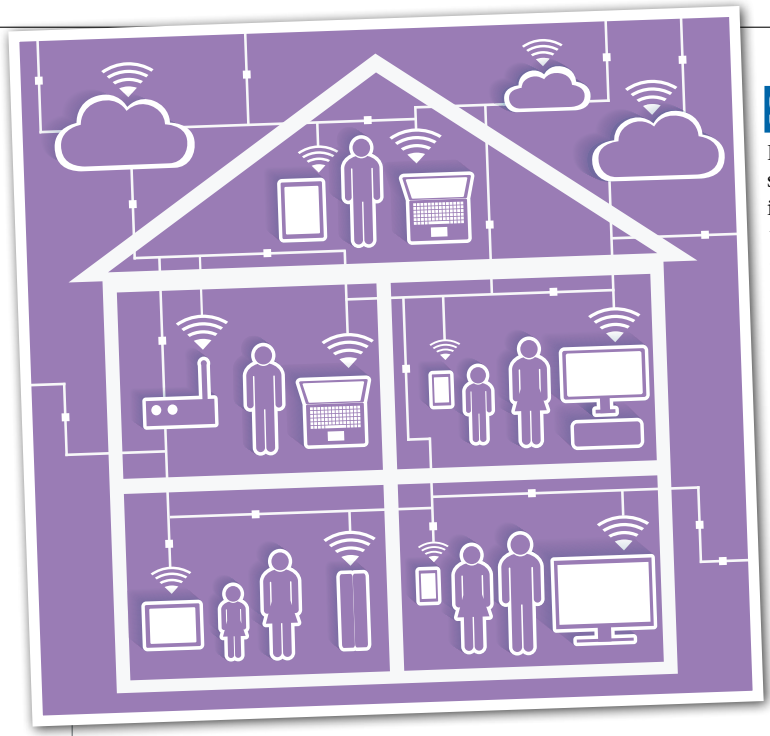
Registering the router was a bit of a drag, too, but this was partly my own fault: I did it from the Nebula web interface, by turning the router upside-down and painstakingly copying out its MAC address and serial number into the online form. If I hadn't peremptorily refused to install the Nebula app on my phone (I'm dealing with too many bleeding apps already), I could have done this just by scanning the QR code on the underside of the router.

With that done, I was immediately able to explore and configure the router's settings from the Nebula interface. It's an impressively comprehensive and integrated environment, and this is both a good thing and a bad thing.

The problem isn't just that there's a lot of advanced router functions that you don't need to know about; the same applies to plenty of domestic routers. Because Nebula is designed to work as a single portal for networks of almost any size and complexity, it also has plenty of options for configuring features your particular router doesn't even have, along with further add-ons such as switches and mobile hotspots. Although the layout is generally clean and clear, it feels quite daunting compared to any home router interface.

It doesn't help that the very basic settings you need to get started – such as the name and passphrase for your wireless network – are hidden away in subframes of submenus of configuration pages. I get why this is: these details are probably going to be entered once, the first time you set up the router, and then never changed, so it would make no sense to put them front and centre in the interface. Still, when you're used to the quick-start wizards that are almost ubiquitous on domestic routers, it's a brutal welcome to the world of professional networking.

BELOW The Zyxel AX6000 router is perfect for small home offices



RIGHT The Security Router performed well all over the house

Still, fair play to Zyxel: things got a lot easier when I realised that the cryptic "Intent" button lets you type in what you want to achieve, and comes back with AI-assisted links to relevant features and settings.

WI-FI UPS AND DOWNS

Once I'd figured out where to find Nebula's Wi-Fi settings, it was an absolute breeze to set up the Security Router. You can configure up to eight independent SSIDs, so I set up ones with the same names and passphrases as my old personal router – this allowed me to decommission the old router without interrupting the service to my phone, smart TV, Alexa devices and so on. I left the original Zyxel SSID as a fresh secure network for my work devices: the flick of a switch ensured its traffic would be isolated from the household stuff.

So far, so good; things got a little more complicated when I tried to attach an additional wireless AP. I had ordered this thinking it would help me propagate the Wi-Fi signal all around my home, but what I hadn't thought through is the fact that it needs to be connected to the router via Ethernet. This is fine for offices equipped with under-floor cable runs and socket boxes, but hardly convenient or neat for a family home – and the AX6000 Security Router doesn't support wireless mesh-style connections.

Happily, it turned out that I didn't need the AP to get respectable whole-home coverage, as I'll discuss below. And the other benefits of using standalone access points – for convenient roaming and load balancing, or to broadcast different networks in different parts of the premises – are unlikely to be necessary for a home office anyway. If you want to extend the range of one or more of your wireless networks, an ordinary Wi-Fi repeater or powerline extender will do the job just fine.

PERFORMANCE IS A NON-ISSUE

When choosing a domestic router, the top priorities are usually either performance or range (which are of course intertwined anyway). If you're switching to a router that's designed to be partnered with external access points, you might fear that its own Wi-Fi capabilities will be on the puny side.

YOU CAN CREATE AN SSID SOLELY FOR KIDS' DEVICES AND SET IT TO TRANSMIT ONLY BETWEEN CERTAIN TIMES ON CERTAIN DATES

In fact, the Security Router is pretty well equipped. Although it's limited to regular Wi-Fi 6, with no support for the 6GHz radio band, it can handle connection speeds of up to 4.8Gbits/sec on the 5GHz band and 1.2Gbits/sec for 2.4GHz connections. I put it through my usual performance tests and was happy to see short-range download speeds of around 100MB/sec. The Security Router even did pretty well in the infamous bathroom test, delivering downloads at a respectable 28MB/sec at the far end of my home. Uploads were generally only half as fast as downloads, but that's not unusual – and there's still certainly enough performance here for almost any serious purpose.

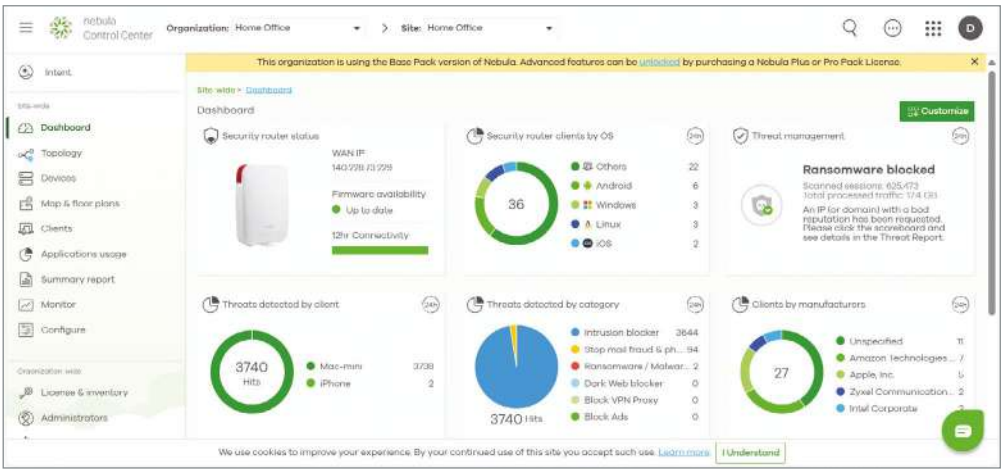
SECURITY IS JOB ONE

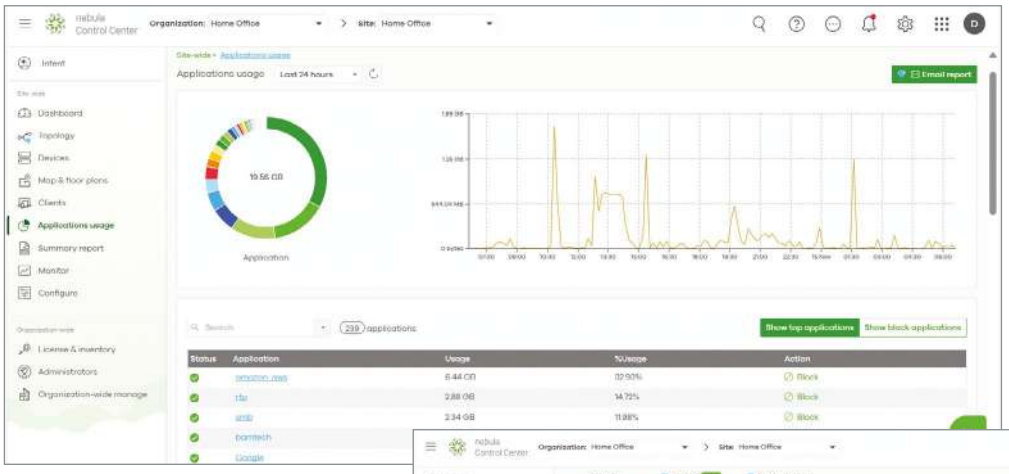
I've mentioned that wireless settings aren't front and centre in the Nebula interface, so what is? Answer: a graphical dashboard showing a selection of charts and statistics about the past 24 hours of activity on your network. You can customise which widgets appear here, but the default selection includes no fewer than three different security readouts, covering multiple kinds of threat, including phishing, ransomware and attempted intrusions, as well as unauthorised attempts at VPN access and unwanted ads.

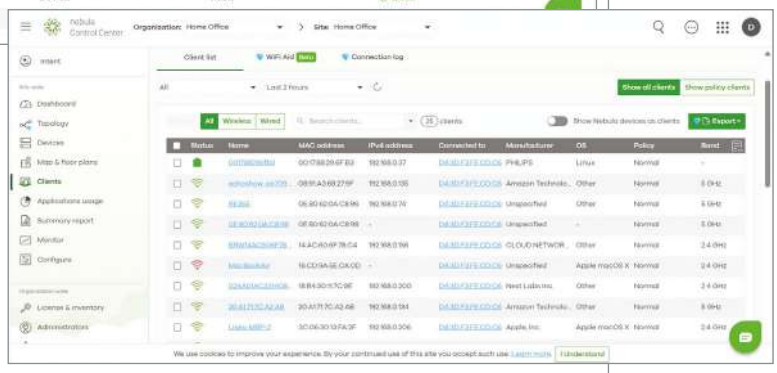
As its prominence implies – and as the very name of the router makes clear – this is really the heart of the Zyxel system. Businesses want fast Wi-Fi, but what they need is security. And this, more than anything else, is what materially separates a professional network from a home one: I've reviewed an awful lot of domestic routers in my time, and none of them offers anything like this degree of scrutiny and detail.

As well as identifying threats, the Security Router includes a highly configurable firewall, and impressive traffic-monitoring and management capabilities. Nebula does an amazing job of identifying which programs and services have been exchanging data, and if you click into the widget you can see which clients they're running on, and optionally block the individual apps with a click. I can honestly say I've never seen a mainstream router that comes close to this degree of transparency and control. Even if the information is entirely anodyne and no action is required – which of course is the situation you'd hope to be in most of the time – just having it so easily available is immensely reassuring.

BELOW The dashboard offers an amazing amount of detail







THE LICENCE IS GENUINELY OPTIONAL

While the Security Router's capabilities are impressive, the bit that really shocked me is that they're free. You can manage your network devices, squash threats, inspect traffic and generally work Nebula like a pro without forking out a penny.

It's true, if you stick with the free service, the web portal does indulge in some very gentle nagging – a little yellow bar appears along the top of the interface, lightly reminding you that you can upgrade at any time, and a few features appear in the interface with a little blue diamond next to them, indicating that they're only available to paying subscribers. Normally I find this sort of "look what you could have" design rather distasteful, but it only appears in a handful of places in the interface, and none of the locked features is one you're likely to need for a home office.

If you're curious about investing, however, there are three paid-for tiers of the Nebula service. The Plus pack extends the monitoring windows from 24 hours to seven days, and adds features including advanced reporting, scheduling for firmware updates, email notifications and Wi-Fi vouchers, which allow network access for a limited time. The Pro pack keeps statistics for up to a year, and adds some enterprise-type stuff such as organisation-wide logs and configuration templates, plus advanced Wi-Fi health monitoring and reporting.

Finally, the Elite pack adds category-based web filtering and an upgraded real-time threat detection engine powered by Trellix, as well as all the stuff included in the Pro plan. If you're running your family network off the Zyxel router you might find it a bit annoying that you can't get web filtering without having to pay for all the other Elite pack stuff, but subscriptions are cheap enough that it's hard to feel too hard done by. You can get a year-long Plus pack for one router for £12 exc VAT, while the Pro pack is £27 a year and the Elite pack is £38, with additional discounts available for multi-year subscriptions. I'll freely admit I was expecting business-class services to be ten times the price.

On the subject of multi-year services, it's worth mentioning that many Zyxel business routers come with a "limited lifetime guarantee" (which in reality means they'll continue supporting the device until five years after it goes off sale). The entry-level router and AP I tried come with a less generous two-year warranty – not quite up to blue-chip standards, but generally on par with consumer-oriented alternatives.

ABOVE Nebula displays plenty of information about your network activity and devices

BELOW There are no built-in parental controls, but you can create your own

WHAT'S THE DOWNSIDE?

The main compromise with my professional networking setup is ease of use. Even though the Nebula interface is quite clean, it really requires you to switch into a corporate mindset, and think of your router and clients as elements in a larger theoretical framework.

On the plus side, this powerful model means that features that might appear to be missing can often be emulated, if you don't mind engineering them yourself. For example, while there's no parental control feature as such, you can create an SSID solely for kids' devices and set it to transmit only between certain times on certain dates – and if you've paid for the Elite pack, you can apply a web filtering policy only to that group of devices.

Another feature you might seek is the ability to route your internet connection through a third-party VPN server, or even to use different servers for different clients. While there are no jolly integrations with the likes of ExpressVPN or NordVPN, you can set up your own routing over IKEv2. You'll just need to find and enter the technical settings for the VPN servers you want to use, and if you want different clients to use different servers you'll also need to set up a private subnet for each one.

Overall, as a home-worker myself, my experience with the AX6000 Security Router has been almost entirely positive. Its versatility, transparency and security features strongly incline me to stick with it for the long term (perhaps with a Wi-Fi 7 router as an access point) – and it's remarkably cost-effective, too.

Would I recommend it to other small business operators? The truth is, if you're not already somewhat au fait with networking technicalities, and don't have a dedicated IT department to help you get set up, you might need a crash course in how it all fits together to get the best from the Nebula platform. Then again, since modern business is so heavily reliant on online communications, a greater awareness of the workings of your own network is no bad thing. ●

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Apple Mac mini M4

PC PRO A-LIST

Half the size of its predecessor yet packing far more power, this is the biggest Mac upgrade of the year

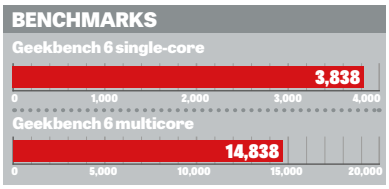
SCORE ★★★★★

PRICE As reviewed, £665 (£799 inc VAT)

from apple.com/uk

The Mac mini has always been compact and affordable, but the 2024 model raises the stakes in both regards. It's smaller than ever, thanks to the first major redesign in 14 years, and while the £599 starting price is the same as the previous M2 version (*see issue 343, p60*), you now get much more computing power for the money.

That's impressive, because the M2 Mac mini was already excellent value. Even today you'd struggle to find a sub-£600 Windows 11 PC to match its performance. Now the new mini gets the same 10-core M4 processor as found in Apple's flagship iPad Pro and MacBook Pro devices (*see p50*). Obviously the fact that the mini doesn't have a built-in screen helps reduce the cost, but still, getting that sort of power for around half the price is an insane deal.



The M4 chip isn't the only major upgrade. The entry-level model now comes with a baseline 16GB of unified memory, doubling the standard amount of the M2 version. This makes the new mini better at multitasking and AI workloads out of the box, and it should be more future-proof, too.

For those who need more, the M4 Mac mini can be upgraded to 24GB or 32GB, although this must be done at the point of purchase and adds considerably to the price. It's a similar story with storage: you can upgrade all the way up to 2TB, but doing so doubles the cost of the base mini. For the most demanding roles, Apple also offers variants that use the enhanced M4 Pro processor, with more cores, up to 64GB of RAM and a maximum of 8TB of onboard storage – with the fully loaded spec coming in at a cool £4,599.

Truly mini at last

Apple calls the redesigned mini its "smallest computer ever", and in terms of the macOS platform that's undeniably true. It measures only 127 x 127 x 50mm, easily fitting in the palm of your hand: put it on the desk next to the last-generation model and it makes the latter look positively bulky.

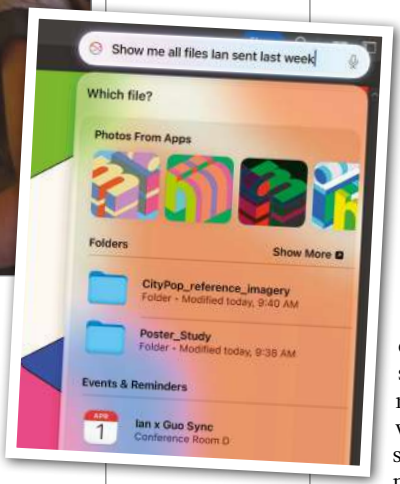
ABOVE Tiny, light and bags of power, all at a reasonable price: what's not to like?

"Apple calls the redesigned mini its smallest computer ever, and in terms of the macOS platform that's undeniably true"

Admittedly, the redesign has added height to the mini, making it more boxy than its predecessor. But it will still easily fit behind a monitor, or indeed beneath one – it's unobtrusive enough that you'll hardly notice it.

Another change to the design is that, where the old mini had all its connections at the rear, the new model comes with two front-facing 10Gbits/sec USB-C ports, alongside a headphone socket for easy access. The power port is at the back, and impressively, despite the mini's size, there's still no bulky external PSU. Next to it sit an HDMI connector, an Ethernet port – gigabit is standard, but you can boost it to 10GbE for an extra £100 – and three further USB ports that are even faster than the front-facing ones. On the standard M4 mini these support Thunderbolt 4, allowing speeds of up to 40Gbits/sec, while on M4 Pro models all three are upgraded to Thunderbolt 5, with a massive 120Gbits/sec of bandwidth apiece.

On the whole it's a smart and practical design, but one element has caused controversy: the placement of the power button. Rather than being



LEFT The M4 chip will deal with whatever tasks you throw at it

ABOVE The upcoming Apple Intelligence features should work smoothly on the mini

situated at the rear, as with previous models, it's now on the underside by the rear left-hand corner, meaning you must physically lift the computer to reach the button. But since the whole thing is so small and light this really isn't a problem unless you want to mount the Mac mini on the back of a monitor or somewhere else with restricted access.

There's nothing more to explore. The box contains only the mini itself and a power cable; you'll need to provide your own screen, keyboard, mouse and cables. Apple has recently released updated versions of its Magic Keyboard, Mouse and Trackpad, now with convenient USB-C charging in place of the proprietary Lightning connector, but any accessories that support USB or Bluetooth should work. Just note that the new mini has no full-size Type-A ports, so you might need to buy an adapter.

M4 roar

Since the introduction of Apple's M-series processors in 2020, Mac performance has ranged from great to fantastic. Unsurprisingly, the new M4 chip – see more on this on p46 – puts the mini towards the latter end of the scale. The model I tried had a standard 10-core processor, along with the basic 16GB of unified memory, and it worked brilliantly: macOS Sequoia booted quickly, and every app I used loaded speedily and ran smoothly. Even when editing videos in Adobe Premiere Pro, the Mac mini breezed along as I added 4K footage and scrolled between scenes.

I was also pleasantly surprised by how well the mini handled 3D gaming. It can't compete with a custom gaming PC, but it ran *Shadow of the Tomb Raider* with high graphical settings at 44fps, well above the 30fps I consider to be the minimum for a game to be playable.

Benchmarks confirm that the new mini represents a respectable step up from the already fast M2 model. I saw a 20% increase in CPU performance in Geekbench 6, with a GPU improvement of between 5% and 14%.

The biggest upgrade is to AI performance. Alongside the extra RAM that helps ensure AI tasks won't overwhelm the system, the Neural Engine in the M4 is much more powerful than the one in the M2, delivering a claimed 38 TOPS versus the older chip's 26. I saw a performance improvement of around 35% in AI benchmarks, which suggests we're in for a smooth ride with upcoming Apple Intelligence features. The ones I've been able to try out so far already feel quite slick, such as the AI-powered Clean Up feature in the Photos app, which intelligently removes unwanted elements from your snaps. However, although it was quick and easy to use, the AI did leave behind giveaway mistakes and glitches – this is a journey we're still near the start of.

As well as being fast, Apple's M-class chips are exceptionally power-efficient. You might think this only really matters for laptops needing to eke out the best possible battery life, but the Mac mini also benefits, as it means the chipset generates little heat and requires minimal cooling. Through almost all of my time using the new Mac mini, the fan was virtually silent – which is great when using it in an office or studio, and also makes the mini ideal if you're looking for a living-room media station.

Time to go small?

When the M2 Mac mini came out at the start of 2023, it shot straight onto our A-List. The new model easily replaces it, with twice the RAM and a significantly more powerful processor – not to mention a delightfully dinky new design – for the same, almost laughably low price.

If there's anything about the package to criticise, it's the way the price rockets up as soon as you start upgrading the base model. That's an issue you may need to grapple with, as you'll find it very easy to fill up the basic 256GB of storage if you want to work with photos or videos, or install a collection of 3D games. Still, thanks to Thunderbolt there's always the option of connecting fast external storage. And the standard M4 I tested performed so well, across every task I tried, that I'd suggest only those with specialist requirements need to think about moving up to an M4 Pro.

"When the M2 Mac mini came out at the start of last year it shot straight onto our A-List. The new model easily replaces it"

For anyone keen to dip a toe into the macOS ecosystem, the Mac mini is the perfect entry point. In fact, it should be very high on the shortlist of anyone interested in a small-format desktop, even if you're not bothered about the Apple factor. There's not a single Windows 11 PC out there that comes close to this combination of neatness, price and performance, and frankly I don't see one catching up with the Mac mini for a long time. **MATT HANSON**

UPGRADE PRICES AND AVAILABLE CONFIGURATIONS

	M4	M4 Pro (12-core)
Starting price	£599 (16GB/256GB)	£1,399 (24GB/512GB)
24GB memory	£200	Included
32GB memory	£400	Not offered
48GB memory	Not offered	£400
64GB memory	Not offered	£600
512GB SSD	£200	Included
1TB SSD	£400	£200
2TB SSD	£600	£600
4TB SSD	Not offered	£1,200
8TB SSD	Not offered	£2,400
10GbE	£100	£100
Max price	£1,749	£4,499

*Price inc VAT from apple.com/uk

BELOW The Mac mini now has two USB-C ports and a headphone connector on the front

SPECIFICATIONS

10-core Apple M4 chip with 10-core GPU • 16GB unified memory • 512GB M.2 PCI-E Gen4 SSD • HDMI 2 • 3 x Thunderbolt 4/USB-C 4 ports • 2 x USB-C 3.2 Gen 2 • gigabit Ethernet • 3.5mm headphone jack • Wi-Fi 6E • Bluetooth 5.3 • 127 x 127 x 50mm (WDH) • 670g • macOS Sequoia • 1yr limited warranty

Apple M4 series

Don't expect revolution, but this is a notable all-round upgrade in performance for all members of the series

COMPARISON CHART

	M4	M4 Pro	M4 Max
CPU cores	Up to 10 (4P, 6E)	Up to 14 (10P, 4E)	Up to 16 (12P, 4E)
GPU cores	Up to 10	Up to 20	Up to 40
NPU	38 TOPS	38 TOPS	38 TOPS
Thunderbolt 5?	✗	✓	✓
Max memory	32GB	64GB	128GB

The Apple M4 series powers the iPad Pro along with the new Mac mini, iMac and MacBook Pro, all of which we happen to review this month. Featuring what Apple calls "second-generation" 3nm core architecture, a faster neural engine and far more memory bandwidth, there's much to admire.

The plain M4 sits at the bottom and supports up to 32GB of unified memory (16GB is the new default). It provides 120GB/sec of bandwidth, a 17% jump on its predecessor. Perhaps more telling is that Apple claims that the M4 is up to 1.8x faster "in multithreaded performance" than the M1, and that the "performance core is the world's fastest CPU core" in terms of single-threaded tasks.

These hyperbolic claims aren't unusual for Apple, but there's good evidence to suggest they're justified. In particular, take a look at the Geekbench 6 single-core results in the graph to the right. Not only is the M4 significantly faster than the M3 family, but also a chunk faster than any other silicon we've tested.

The M4 comes with four performance cores and up to six efficiency cores, giving ten in total, so while it pushes the M4 Pro close in Geekbench 6's single-core tests it falls behind everywhere else. Note that if you buy an iMac, you can buy it with either eight CPU cores or ten CPU cores, and it's the same story for the GPU. Here, you're benefitting from hardware-accelerated ray tracing and mesh shading, with Apple promising that it's twice as fast as the M3 in ray-tracing tasks and up to 2.1x faster than the M1 for "graphically intensive tasks" such as 3D design. The Blender and Handbrake graphs give a clear indication of its power.

There's also the neural engine, which is capable of 38 TOPS compared to the Apple M3's 18 TOPS. This is exactly what you'll need if you want to take advantage of the new Apple Intelligence tools, which are being rolled out to macOS in December. It doesn't matter which version of the M4 family you buy: the neural engine (or NPU) is the same.

Apple sells the M4 Pro in two varieties: one with 12 CPU cores and 16 GPU cores, the other with 14 CPU cores and 20 GPU cores. Apple claims that the M4 Pro "delivers up to 45% faster multithreaded CPU performance than the M3 Pro", but that's for the 14-core version; note the two extra CPU cores are both performance rather than efficiency. Along with more memory – up to 48GB for a MacBook and 64GB for the Mac mini – it also comes with greater bandwidth, now up to 273GB/sec.

You also get support for Thunderbolt 5 while the M4 sticks with plain old Thunderbolt 4.

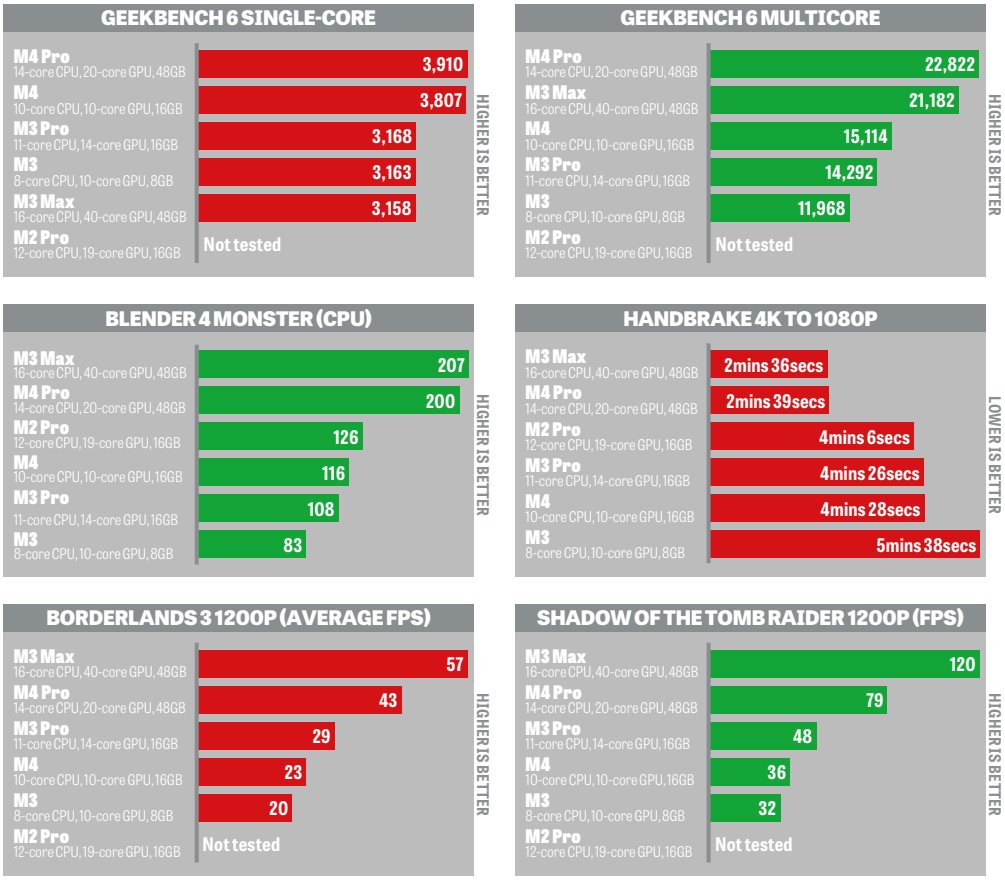
Finally we come to the M4 Max, which we haven't yet had a chance to test. This offers two more CPU cores than the Pro, with a maximum of 16 (four are efficiency cores, so you get either ten or 12 performance cores). Apple reckons it's up to 18% faster in multithreaded performance compared to the M3 Max, and 2.4x faster than the M1 Max.

ABOVE Apple's latest silicon pushed our benchmarks to the max

"Not only is the M4 significantly faster than the M3 family, but also a chunk faster than any other silicon we've tested"

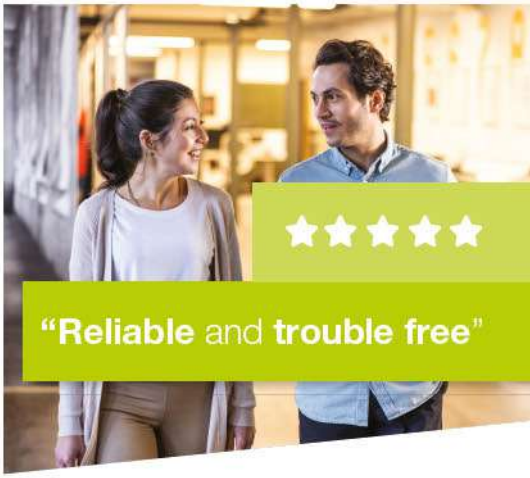
But it's the GPU where the M4 Max really pulls ahead, with either 32 or 40 cores. Apple claims it's up to 25% faster than the M3 Max. The M4 Max supports up to 128GB of memory with a peak bandwidth of 546GB/sec, twice that of the M4 Pro and 30% more than the M3 Max. Finally, the plain M4 supports up to 15 streams of 4K ProRes video, while the Pro goes up to 37 and the M4 Max up to 66.

It adds up to a significant upgrade over the M3 family, and a huge lift over the M1 and M2. **JOHN LOEFFLER**


GEEKBENCH 6 SINGLE-CORE
M4 Pro 14-core CPU, 20-core GPU, 48GB 3,910
M4 10-core CPU, 10-core GPU, 16GB 3,807
M3 Pro 11-core CPU, 14-core GPU, 16GB 3,168
M3 8-core CPU, 10-core GPU, 8GB 3,163
M3 Max 16-core CPU, 40-core GPU, 48GB 3,158
M2 Pro 12-core CPU, 19-core GPU, 16GB Not tested
HIGHER IS BETTER
GEEKBENCH 6 MULTICORE
M4 Pro 14-core CPU, 20-core GPU, 48GB 22,822
M3 Max 16-core CPU, 40-core GPU, 48GB 21,182
M4 10-core CPU, 10-core GPU, 16GB 15,114
M3 Pro 11-core CPU, 14-core GPU, 16GB 14,292
M3 8-core CPU, 10-core GPU, 8GB 11,968
M2 Pro 12-core CPU, 19-core GPU, 16GB Not tested
HIGHER IS BETTER
BLENDER 4 MONSTER (CPU)
M3 Max 16-core CPU, 40-core GPU, 48GB 207
M4 Pro 14-core CPU, 20-core GPU, 48GB 200
M2 Pro 12-core CPU, 19-core GPU, 16GB 126
M4 10-core CPU, 10-core GPU, 16GB 116
M3 Pro 11-core CPU, 14-core GPU, 16GB 108
M3 8-core CPU, 10-core GPU, 8GB 83
HIGHER IS BETTER
HANDBRAKE 4K TO 1080P
M3 Max 16-core CPU, 40-core GPU, 48GB 2mins 36secs
M4 Pro 14-core CPU, 20-core GPU, 48GB 2mins 39secs
M2 Pro 12-core CPU, 19-core GPU, 16GB 4mins 6secs
M3 Pro 11-core CPU, 14-core GPU, 16GB 4mins 26secs
M4 10-core CPU, 10-core GPU, 16GB 4mins 28secs
M3 8-core CPU, 10-core GPU, 8GB 5mins 38secs
LOWER IS BETTER
BORDERLANDS 3 1200P (AVERAGE FPS)
M3 Max 16-core CPU, 40-core GPU, 48GB 57
M4 Pro 14-core CPU, 20-core GPU, 48GB 43
M3 Pro 11-core CPU, 14-core GPU, 16GB 29
M4 10-core CPU, 10-core GPU, 16GB 23
M3 8-core CPU, 10-core GPU, 8GB 20
M2 Pro 12-core CPU, 19-core GPU, 16GB Not tested
HIGHER IS BETTER
SHADOW OF THE TOMB RAIDER 1200P (FPS)
M3 Max 16-core CPU, 40-core GPU, 48GB 120
M4 Pro 14-core CPU, 20-core GPU, 48GB 79
M3 Pro 11-core CPU, 14-core GPU, 16GB 48
M4 10-core CPU, 10-core GPU, 16GB 36
M3 8-core CPU, 10-core GPU, 8GB 32
M2 Pro 12-core CPU, 19-core GPU, 16GB Not tested
HIGHER IS BETTER

All chips tested in MacBook Pro 14in/16in laptops

brother
at your side



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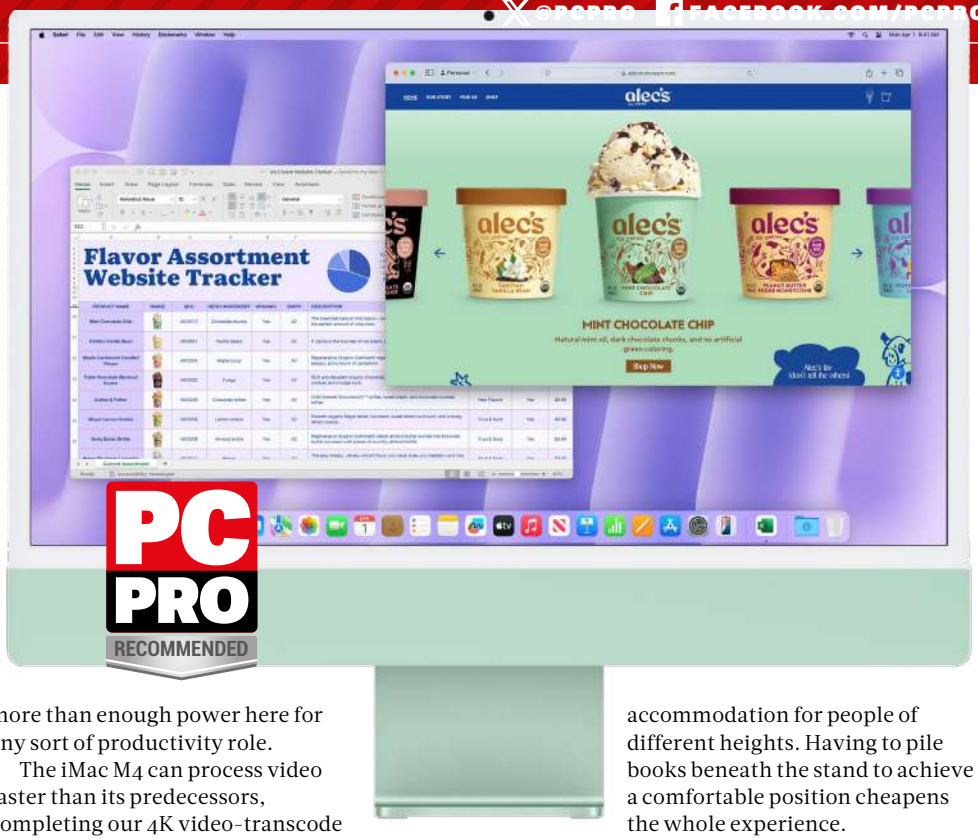

Apple iMac M4

A minor and unexciting upgrade, but when so much was already right about the iMac it's hard to complain

SCORE ★★★★☆

PRICE As reviewed, £1,249 (£1,499 inc VAT) from apple.com/uk

PC PRO RECOMMENDED

Alongside the new Mac mini (*see p44*) and MacBook Pro (*see p50*) , Apple has updated its iconic all-in-one desktop. It's not a major redesign, but it brings welcome improvements over last year's model – not only the latest M4 processor, but also a doubling of the starting RAM and a better webcam. The colour lineup has been updated, too, with new shades of blue, green, orange, pink, purple and silver.

As always, the defining feature of the iMac is its screen, and it remains as delightful as ever. At 24in it won't dominate your desk, but it provides much more workspace than a laptop, and also works well for video streaming: I watched some of my favourite shows and films on the iMac and was delighted by how bold and vivid colours looked. It has lovely wide viewing angles, too, so you needn't sit directly in front of it for media consumption.

LEFT Wide viewing angles make it ideal for media duties as well as productivity tasks

New in this generation, unless you go for the cheapest model, is the option to add a nano-texture glass coating for £200. It's a pricey add-on, but it does a great job of diffusing glare from nearby windows or lights without harming the overall image quality.

Media duties also benefit from the six-speaker audio array, which does a superb job of enveloping you in sound – doubly so if your source uses Dolby Atmos or Spatial Audio. While it won't outperform a good set of desktop speakers, I had a blast listening to tracks on this all-in-one, and that's not something I can say very often.

As for app performance, Apple Silicon always feels snappy, but the M4 processor raises the ante with single-core and multicore Geekbench 6 scores of 3,646 and 14,724 respectively. That's 40% to 60% faster than its M3 predecessor, and around twice as fast as the M1 model. Add in the fact that the entry-level RAM has now been doubled to 16GB and there's more than enough power here for any sort of productivity role.

The iMac M4 can process video faster than its predecessors, completing our 4K video-transcode test almost two minutes ahead of the iMac M3. And, like all M-series iMacs, it will support the upcoming features of Apple Intelligence.

A final point worth mentioning is the iMac M4's upgraded 12MP webcam. This does a great job of capturing fine detail during video calls, and in FaceTime it now supports "Desk View", which literally lets you share a view of what's on your desk in front of the iMac. Alternatively, you can use your phone as a secondary camera, via Apple's Continuity Camera feature, if you have a compatible iPhone.

The iMac M4 does have a few limitations. While it races through desktop tasks, gaming performance is less inspiring: even with a 10-core GPU and 24GB of RAM, it struggled with recent games. In *Baldur's Gate 3* I had to live with 20-30fps, indicating that you'll need to dial down the resolution and graphical settings to enjoy smooth performance.

In terms of ergonomics, the lack of height adjustment is a pain. At 193cm I know I'm taller than average, but there really ought to be some accommodation for people of different heights. Having to pile books beneath the stand to achieve a comfortable position cheapens the whole experience.

ABOVE The gorgeous screen and speedy M4 chip make the iMac a very desirable desktop

Finally, it's certainly not a new issue, but the iMac's continued lack of touchscreen support is becoming harder to overlook. Now that modern Macs can run iOS and iPadOS apps, and even offer full iPhone mirroring, having to use a keyboard and mouse for everything feels distinctly backward.

"Media duties benefit from the six-speaker audio array, which does a superb job of enveloping you in sound"

Despite those gripes, it's impossible to dislike the new iMac. The faster processor won't greatly change the experience for most people compared to the M3, but if you want to get stuck into video or photo editing the extra performance is certainly nice to have, and the extra RAM ensures things will keep running smoothly for a long time to come. It's more than enough of an upgrade to maintain the iMac's position as one of the best all-in-one computers on the market. **ALEX WAWRO**

SPECIFICATIONS

10-core Apple M4 with 10-core GPU ● 16GB unified memory ● 256GB SSD ● 24in 60Hz IPS panel, 4,480 x 2,520 resolution ● 2 x Thunderbolt 4/USB-C 4 ● 2 x USB-A 3.2 Gen 2 ● 1GbE port ● Wi-Fi 6E ● Bluetooth 5.3 ● 1080p webcam ● Magic Mouse ● Magic Keyboard with Touch ID ● macOS Sequoia ● 547 x 147 x 461mm (WDH) ● 4.4kg ● 1yr RTB warranty

BELOW The new iMac is available in a range of eye-catching colours

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VIGOR 5G SERIES ROUTERS

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Apple MacBook Pro M4

The difficult choice isn't whether the M4 MacBook Pro is right for you, but which size and spec to choose

PC PRO A-LIST

SCORE ★★★★★

PRICE 14in from £1,333 (£1,599 inc VAT); 16in from £2,083 (£2,499 inc VAT) from apple.com/uk

Apple's latest MacBook Pro looks and feels a lot like the 2023 model, and it comes in the same 14in and 16in formats as before. However, it brings several upgrades – including a nano-texture screen option, the faster M4 processor and improved battery life – that make it Apple's most compelling high-end laptop yet.

One simple but pleasing change is that you no longer have to pay extra for black. Previously, the bad-ass Space Black finish was only an option on premium MacBook Pro models with the M3 Pro or M3 Max processor, but now it's available as an alternative to standard silver across the whole Pro range. The black chassis makes a striking statement, replete with matching black MagSafe power cord, and the coating on the lid does an okay job of resisting fingerprints. It's just a shame the power brick is still white.

Colour aside, the MacBook Pro M4 looks identical to its predecessor, with an aluminium design that's easy to carry, yet feels rock solid. I continue to appreciate the front lip that makes the lid easy to open, and the Touch ID button for logging in quickly – although I really wish Apple would add Face ID at this point.

Connectivity is improved over the M3 version, with the M4 offering three Thunderbolt ports compared to two previously. On models with a plain M4 chip these use Thunderbolt 4 for connection speeds up to 40Gbits/sec, while M4 Pro and M4 Max variants support the new Thunderbolt 5 standard, capable of going up to 120Gbits/sec. Whichever you choose, you also get an SD card slot, HDMI port and headphone jack; it's pleasing to note that on all models you can now use dual external displays at the same time as the laptop display.

Display of desire

On the subject of the display, one major new feature of the M4 MacBook Pro is the anti-reflective nano-texture glass option. This adds £150 to the price (regardless of whether you're buying a 14in or 16in model) but it does an amazing job of cutting out glare, even in the brightest environments; you really have to see it to fully appreciate the difference it makes.

Behind it sits the same excellent mini-LED panel as previously seen on the M3 MacBook Pro, which is visibly brighter than the screens on the older M1 and M2 models. In our lab tests, the MacBook Pro M4 reached a very impressive 1,527cd/m² when displaying HDR content and 556cd/m² with SDR, beating every other laptop we've seen at around this price. The MacBook Pro's colour accuracy is the best in its class, too, with a Delta E of 0.19 (where zero is perfection).

My only quibble here is that I wish Apple would offer a version with an OLED screen. Although the MacBook Pro's display is wonderfully bright, it can't match the rich contrast of the OLED panel as found on the M4-powered iPad Pro, and indeed on various Windows laptops.

ABOVE The MacBook Pro is a supremely powerful laptop

"M4 Pro and M4 Max variants support the new Thunderbolt 5 standard, capable of going up to 120Gbits/sec"

Webcam wonder

It might seem like a small thing, but one of the great improvements in the M4 MacBook Pro is its webcam, which represents perhaps the biggest generational leap in visual performance I've ever seen. Where the M3 model had a merely decent 1080p camera, the new model uses a 12MP sensor, and I could immediately see a huge difference in image quality when taking selfies using the Photo Booth app.

In practice, of course, you're more likely to be using it for videoconferencing, and it worked brilliantly for that too, capturing plenty of detail and natural colours, even in a poorly lit meeting room. Apple's Center Stage feature means you'll be automatically kept centred in the frame even if you move around, too. If you regularly make video calls for work, the new MacBook Pro will help you make a professional impression.

LEFT The updated webcam will give a good impression in video meetings

Finger-lickin' fast

The 2024 MacBook Pro promises all sorts of performance gains over previous models. As well as design and efficiency improvements (thanks partly to the 3nm manufacturing process), the standard M4 processor has ten CPU cores versus the M3's eight – and all models start with a roomy 16GB of RAM, extendable to a maximum of 128GB on the top-spec M4 Max version.

Even though my review unit had only the base CPU and RAM provision, I found everything extremely fluid and responsive. With multiple apps running and many Slack chats on the go, I could still easily perform complex operations on large image

STARTING PRICES

	M4	M4 Pro (12-core CPU, 16-core GPU)	M4 Pro (14-core CPU, 20-core GPU)	M4 Max (14-core CPU, 32-core GPU)	M4 Max (16-core CPU, 40-core GPU)
14in MacBook Pro	£1,599	£1,999	£2,399	£3,199	✗
16in MacBook Pro	✗	✗	£2,499	£3,499	£3,999

*Price inc VAT from apple.com/uk

files in Pixelmator Pro with zero lag. In the Geekbench benchmark, the M4 MacBook Pro scored 3,807 for single-core performance and 15,114 for multicore – well ahead of the M3's scores of 3,163 and 11,968.

If your daily workflow involves photo editing, you'll also be happy to know that the M4 MacBook Pro scored much better on the PugetBench Photoshop test than competing Windows laptops, and proved almost twice as powerful as the Intel-powered Dell XPS 13 on the Premiere Pro video test. The M4 Pro and Max variants, with up to 14 or 16 CPU cores, can be expected to do even better.

My only disappointment in our testing concerned the SSD. The BlackMagic Disk Speed test rated the 1TB drive in my test system as slightly slower than the one in the M3 model. There's no obvious explanation for this, but it's not the end of the world – in everyday use I couldn't tell the difference.

Graphics and gaming

As well as being a CPU powerhouse, the M4's ten GPU cores make it a capable gaming laptop. I had a blast playing a demo of *Resident Evil 4*: the graphics were lush, with impressive lighting effects as I ran around a muddy nightmare-fuelled landscape, and after connecting a PS5 controller I enjoyed smooth frame rates in *Asphalt Legends Unite*.

Don't expect the fastest performance in demanding titles, though. I got a playable 36fps and 53fps in *Shadow of the Tomb Raider* and *Civilization VI* respectively, but when I fired up *Borderlands 3* the MacBook Pro M4 mustered only 23fps. If gaming performance is a priority, you might want to look into the M4 Pro and Max options: these push up the cost considerably, as you can see from our pricing table opposite, but they upgrade the graphics to 20, 32 or even 40 GPU cores. Or, of course, you could pick a Windows laptop with a dedicated GPU.

Good buy?

Apple claims that the MacBook Pro M4 can run for up to 24 hours on a full charge when streaming video (up from 22 hours in the previous generation), or 16 hours when surfing the web. In fact, in our tests it did even better than that, managing a whopping 18hrs 31mins of continuous web surfing at a screen brightness of 150cd/m² – just over an hour longer than the M3 model. There are a few Windows laptops that last a little longer, but this is very much the upper echelon of longevity.

The M3 MacBook Pro was already a fantastic laptop, and the M4 gets even closer to perfection with superb performance, a much better webcam and even longer battery life. While the screen is unchanged, the new nano-texture coating is also a great improvement that, in my view, warrants the £150 premium.

BELOW All MacBook Pro models are now available in black as well as silver

I do have minor criticisms. SSD performance wasn't as great as the rest of the package, and gaming performance is merely fine. Overall, though, if I needed to buy a laptop tomorrow, it would be an M4 MacBook Pro. Even if it's overkill for my needs, I don't care: it's one of the best laptops anyone has ever produced. **MARK SPOONAUER**

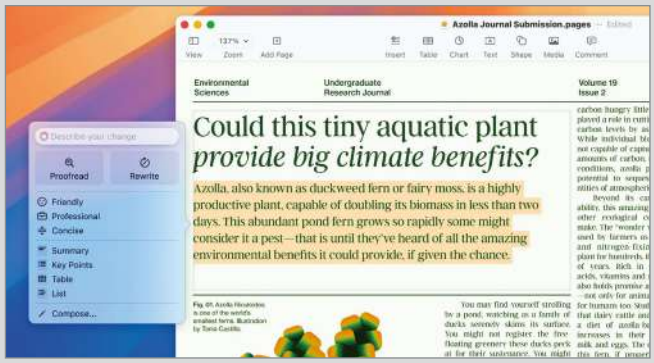
SPECIFICATIONS

MacBook Pro 14in: M4, M4 Pro or Max chip • 16GB to 128GB unified memory • 512GB to 8TB M.2 PCI-E Gen4 SSD • 14.2in non-touch 120Hz mini LED display, 3,024 x 1,964 resolution • 72Wh battery • 313 x 221 x 15.5mm (WDH) • 1.6kg. **MacBook Pro 16in:** M4 Pro or M4 Max chip • 24GB to 128GB unified memory • 512GB to 8TB M.2 PCI-E Gen4 SSD • 16.2in non-touch 120Hz mini LED display, 3,456 x 2,234 resolution • 100Wh battery • 356 x 248 x 16.8mm (WDH) • 2.1kg. **Shared:** Wi-Fi 6E • Bluetooth 5.3 • 3 x USB-C 4/Thunderbolt 5 ports (Thunderbolt 4 for M4) • HDMI • SDXC card slot • 3.5mm headphone jack • MagSafe 3 charger • 12MP Center Stage webcam • macOS Sequoia • 1yr RTB warranty

macOS Sequoia and Apple Intelligence

Before we dig into all the Apple Intelligence features, which will come with an update, macOS Sequoia includes a bunch of new features. First, it finally includes easier window tiling: drag and drop the window you want to dock to the left side or right side of the screen and the OS snaps them into place.

Another highlight is iPhone Mirroring, which means you can easily use your iPhone on your Mac even if it's in another room. I tried this and it connected almost immediately, complete with all my apps and notifications. You can also drag and drop photos and videos from one to the other, if, for example, you want to create something quickly in your favourite iOS app. Other welcome Sequoia features include a new Passwords app for improved password management, new effects in messages and audio transcription in the Notes app.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Volume 19 Issue 2
Could this tiny aquatic plant provide big climate benefits?
Azolla, also known as duckweed fern or fairy moss, is a highly productive plant, capable of doubling its biomass in less than two days. This abundant pond fern grows so rapidly some might consider it a pest—that is until they've heard of all the amazing environmental benefits it could provide, if given the chance.
Proofread
Rewrite
Friendly
Professional
Concise
Summary
Key Points
Table
List
Compose...

ABOVE Writing Tools lets you make handy summaries in an instant

But Apple Intelligence is the star of the show, which I played with after upgrading to the developer beta of macOS 15.2. Writing Tools is especially handy, as it works with any app and lets you quickly summarise a long note with ease (though you have to select all the copy first). You can format this in multiple ways, such as key points, and then (for example) copy that summary and put it at the top of your document. It can also rewrite or proofread your copy, making your tone sound more professional or more chatty, whichever you prefer.

I really like having a smarter Siri on board. Yes, you can talk to the assistant, but I found typing easier using the dedicated glowing icon in the top right of the display. I could ask follow-up questions (such as "how about the next week?" after asking about the weather today), and I also appreciate that you can get step-by-step instructions on all sorts of things you want to do on your Mac, from setting up iPhone Mirroring to recording your screen.

You can push things even further with ChatGPT. I asked the assistant to generate an image of a golden retriever underneath a rainbow, and it came back in seconds. Another handy feature is Clean Up. This did a remarkable job finding things I might want to remove from a portrait photo, and the result looked realistic. So there's already plenty to play with in Apple Intelligence, and it leaves me even more optimistic about what's to come.

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SCAN

Lenovo ThinkPad P1 Gen 7

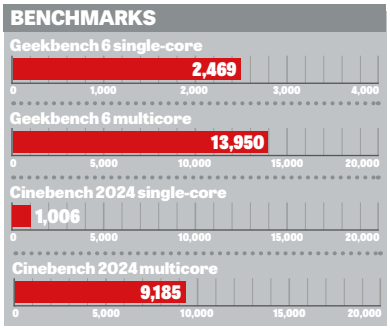
A creative workstation that can take on almost any workload thanks to great cooling and pro graphics

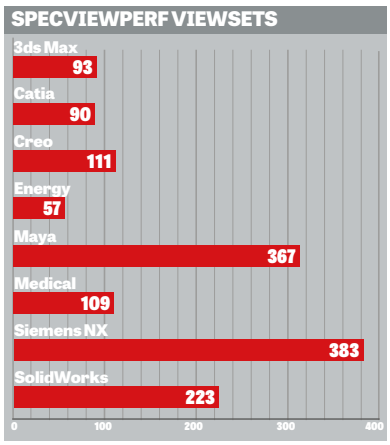
SCORE ★★★★★

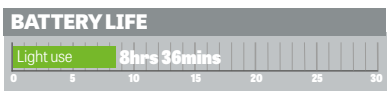
PRICE As reviewed, £3,375 (£4,050 inc VAT) from lenovo.com/uk

Lenovo pitches its P1 ThinkPads as mobile workstations, geared towards professionals – architects, video editors, 3D designers – who need to work on the move.

This seventh generation sparks interest as it introduces LPCAMM2 memory. Standing for low power compression attached memory modules, they're smaller than SODIMMs so can fit into tight spaces, which avoids the need for integrating memory onto boards. It's also fast. Lenovo uses memory rated at 7,467MT/sec, or megatransfers per second; a better measure of memory speed than megahertz. You can replace the P1's LPCAMM2 module yourself, up to a maximum of 64GB, but the supplied 32GB is respectable.







AI power

Lenovo is also pitching this new P1 as an AI creative workstation, but don't expect too much help from the CPU. The Core Ultra 9 185H doesn't even meet Microsoft's criteria for Copilot+ status as its 11 TOPS NPU isn't powerful enough. The 185H offers 34 TOPS in total, but most of that comes from its integrated Arc graphics, which aren't used here.

Instead, our test system features Nvidia's RTX 2000 Ada Generation. This packs 3,072 CUDA cores, 24 third-generation RT cores and 96 fourth-generation Tensor cores, which combine to give a 232 TOPS rating (FP8 TOPS with Sparsity).

We currently use Geekbench AI 1.1 to measure AI performance. In its ONNX DML test, the ThinkPad P1 Gen 7 returned 14,706 in the single precision section, 24,527 in half precision and 11,367 quantised. That compares to 2,743, 1,110 and 2,171 for the LG gram SuperSlim (*see p57*).

The GPU also provides plenty of acceleration in games. The P1 averaged 133fps at the highest settings in *Shadow of the Tomb Raider* at 1080p, and a strong 72fps in *Cyberpunk 2077* with Ultra settings. Switching to the screen's native resolution of 2,560 x 1,600, those figures fell to 98fps and a still playable 38fps respectively. Dropping from Ultra to High in *Cyberpunk* pushed that average up to 52fps, so there's gaming potential here. I turned to 3DMark to measure DirectX 12 and ray tracing performance, and results of 9,321 in Time Spy, 5,237 in Port Royal and 2,307 in Speed Way are all solid results.

ABOVE Design of the times: the P1 ThinkPad has been built with creatives in mind

PC PRO RECOMMENDED

"This seventh generation introduces LPCAMM2 memory. They're smaller than SODIMMs so can fit into tight spaces"

ABOVE The excellent keyboard and haptic trackpad make for a fine user experience

But it's performance in creative apps that surely matters to buyers of this laptop. We print the full figures in each of SPECviewperf 20's viewsets to the left, and it's much faster than systems that rely on even high-end GeForce RTX chips in the Siemens NX and Medical viewsets. It's only when compared to the desktop workstations in our most recent group test (*see issue 361, p78*) that it looks slow, being roughly half as fast as £4,500 systems in 3ds Max, Catia, Creo and Maya.

Lenovo offers the P1 in cheaper configurations based around either GeForce RTX 4060 graphics, an RTX 1000 Ada Generation GPU or Intel's integrated Arc graphics alone, so you have options depending on your budget and usage.

Screen test

You can also buy the P1 with a variety of screens; here, Lenovo selected the non-touch IPS version that typically peaks at 500cd/m² and reached 511cd/m² in our tests. That's a great result, and the panel excelled for colour accuracy, with an average Delta E of 0.34 and peak of 0.77. More subjectively, whites look great and its viewing angles are strong.

I wouldn't recommend this panel for video work, however, as it only covers 73% of the DCI-P3 gamut. Print designers won't be impressed by 71% of the Adobe RGB space, either. It's tuned instead to the sRGB gamut, covering 98% out of a 104% volume.

Professional video editors should choose the 3,840 x 2,400 OLED panel,

which also supports touch, as Lenovo claims it covers 100% of the DCI-P3 space, but this adds £350 to the price.

OLED technology has an effect on battery life, and that isn't a strength of the P1 Gen 7 despite a 90Wh battery. It lasted for 8hrs 36mins of light use, which reflects the demanding core components. That's also why it ships with a chunky 170W power adapter, but it's extremely effective – the P1 went from empty to 57% in 30 minutes and was 90% full after an hour.

Body of evidence

Two USB-C 4/Thunderbolt 4 ports on the left can also be used to charge the laptop, with Power Delivery up to 135W. They're accompanied by an HDMI 2.1 port and 3.5mm combo jack, while on the right sit a USB-C 3.2 Gen 2 port, a USB-A 3.2 Gen 1 port and an SD Express 7 card reader. Wi-Fi 7 and Bluetooth 5.4 complete the set, with the only omission being an RJ45 port.

Despite all this connectivity, Lenovo has kept the P1 Gen 7 to a slender 17mm depth and a 1.8kg weight. It's built to the high standards we would expect of a ThinkPad, too, with an aluminium chassis that provides excellent protection for the lid.

The spill-resistant keyboard has a crisp feel, while a concave design for the key tops means your fingers nestle into them; touch typists should reach excellent speeds. The cursor keys are almost full size and separated, with no function doubling. Lenovo also takes the executive decision not to include a number pad in this creator-targeted laptop, with only a handful of buttons squeezed down in size: PgUp and PgDn, plus the right-hand Ctrl and Alt keys, to make room for the Copilot key.

My final words of praise go to the large (135 x 85mm) trackpad, with a glass coating to make it feel even more luxurious. There's a TrackPoint, too, but no physical keys: instead Lenovo relies on the fact that this is a haptic trackpad, so when you press the top it comes close to feeling like you're pressing on the left- and right-click keys as normal.

Finishing touches

Everything else about this laptop is as you would expect from a premium ThinkPad. The 1440p webcam produces excellent results, the speakers pump out a well-balanced sound with plenty of bass, and it meets expectations for environmentally conscious buyers.

"Lenovo has left no stone unturned in its attempt to create the world's best mobile creative workstation"

This includes a carbon offset scheme, but more importantly you can easily replace the 1TB M.2 SSD – which is blisteringly fast, with 7,145MB/sec reads and 6,246MB/sec writes – and even add a second. The battery is also customer-replaceable. And where possible Lenovo uses recycled plastics.

Lenovo has left no stone unrendered in its attempt to create the world's best mobile creative workstation. It's expensive, even if you take the three-year on-site warranty into consideration, but that's the price you pay for this level of quality. **TIM DANTON**

BELOW The P1 has plenty of creative power, and even gaming potential

SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 9 185H processor • 8GB Nvidia RTX 2000 Ada graphics • 32GB LPDDRX-7500 RAM • 16in 165Hz IPS non-touch panel, 2,560 x 1,600 resolution • 1TB Performance M.2 PCI-E Gen4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 5MP IR webcam • 2 x Thunderbolt 4/USB-C 4 • USB-C 3.2 Gen 2 • USB-A 3.2 Gen 1 • HDMI 2.1 • 3.5mm combo jack • SD Express 7 card reader • 90Wh battery • Windows 11 Pro • 354 x 241 x 17.1mm (WDH) • 1.8kg • 3yr Premier Support warranty

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SCAN ME

Panasonic Toughbook 40 MK2

The outside stays the same, but a welcome upgrade to Core Ultra chips means it keeps up with the times

PC PRO RECOMMENDED

SCORE ★★★★★

PRICE As reviewed, £3,779 (£4,535 inc VAT) from ultima-computers.co.uk

When I reviewed the Toughbook 40 (*see issue 348, p54*) in 2023, I was full of praise. It's a rugged laptop that thrives in demanding environments, with supreme build quality, incredible flexibility through its array of modular bays and the backup of rapid support from Panasonic's Cardiff base if anything needs to be fixed.

But it had a weakness: speed. Panasonic was still using 11th gen Intel Core processors, and the i5-1145G7 chip I tested limped through our benchmarks with a score of 5,118 in Geekbench 6's multicore section and 5,273 in Cinebench R23.

This MK2 upgrade is a huge improvement, as it ships with Intel's first generation Core Ultra chips: either the Ultra 5 135H or Ultra 7 165H (both of which include Intel's vPro technology for easier remote management). My test sample included the 135H and 32GB of DDR5 RAM, which boosted those test results to 9,472 in Geekbench and 9,569 in Cinebench. 3D acceleration is much improved, too, with 2,964 in 3DMark Time Spy compared to 1,125.

Intel's Core Ultra chips also include an NPU for local AI tasks, with Panasonic claiming that "field workers that have access to wiring diagrams and schematics on their device can combine AI-enabled computer vision technology with the device's camera to accurately show where wiring connections should be". I'd love to hear from someone who does this, or similar AI-enhanced tasks, but suspect the NPU will mainly be used to blur backgrounds in video calls. Unlike Intel's second gen Core Ultra 200V series (*see issue 362, p46*), the NPU isn't powerful enough to support Copilot+ PC features, so OS upgrades may be limited.

But that's the only restriction, as one of the joys of the Toughbook series is its customisability. For example, Panasonic provided a second battery to slip into an expansion bay, contributing to a frankly incredible 32hrs 8mins of battery life. There's still a second bay into which you can slide a DVD writer, Blu-ray drive or extra storage. Or you can replace that second battery with yet more storage.

Other expansion areas are available for you to add your favoured ports, a webcam, fingerprint reader, smart card reader and more. And with flaps to protect the ports from dust and water ingress, the Toughbook 40 MK2 earns an IP66 rating to accompany its MIL-STD-810H certification. Drop this laptop onto concrete and it should survive.

The downside of all this protection is, of course, bulk, but a carry handle and respectable 3.4kg weight mean that the Toughbook 40 MK2 is surprisingly easy to take on your travels. You'll be well connected, too, with Wi-Fi 7 support plus optional 4G or 5G modems.

You might expect a 15.6in screen in a laptop this size, but no: it's still 14in. It's designed for utility rather than entertainment, with the touchscreen even working with gloves and in the rain, so I'm loath to complain about sRGB coverage of 56% or an average Delta E of 4.47. Far more important for those who work covertly at night, the panel drops down to 1cd/m². And it can reach 1,320cd/m² to ensure it's visible in the blazing sun; naturally it's a matte coating rather than glossy.

The keyboard is also designed with practicality in mind, with plenty of travel and spaces between the keys for gloved fingers. Panasonic provides four programmable keys at the top, too. And while the touchpad is small, it's accompanied by two physical buttons for easier usage.

"Expansion areas are available to select your favoured ports, a webcam, fingerprint reader, smart card reader and more"

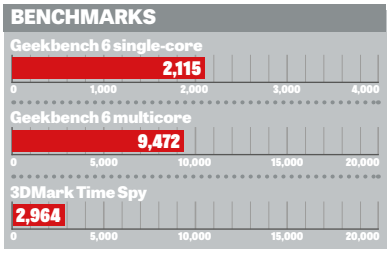
None of this comes cheap, but the Toughbook 40 (shown on some websites as the FZ-40) is a long-term investment. You could wait around for Panasonic to update it with a second-generation Core Ultra chip, but it seems unlikely that the AI benefits are worth it. Up to this point, the Toughbook 40 was the best 14in rugged laptop money could buy; the Toughbook 40 MK2 deservedly steals that accolade. **TIM DANTON**

ABOVE The Toughbook is truly rugged, highly versatile and now packs AI inside

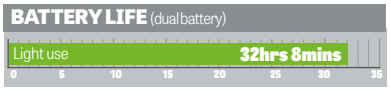
LEFT There are four programmable keys above the keyboard

BELOW The carry handle and IP66 rating mean you can take this laptop anywhere

BENCHMARKS



BATTERY LIFE (dual battery)



SPECIFICATIONS

14-core (4 P-cores, 8 E-cores, 2 LE-cores) Intel Core Ultra 5 135H vPro processor • Intel Arc graphics • 32GB DDR5-5600 RAM • 14in 60Hz IPS touchscreen, 1,920 x 1,080 resolution • 1TB M.2 PCI-E Gen4 SSD • IP66 • Wi-Fi 7 • Bluetooth 5.3 • 5MP IR webcam • Thunderbolt 4 • 2 x USB-A 3.2 Gen 2 • HDMI 2 • UHS-1 microSDXC card reader • gigabit Ethernet • 3.5mm jack • 2 x 68Wh batteries • Windows 11 Pro • 354 x 301 x 54.4mm (WDH) • 3.4kg • 3yr warranty

LG gram SuperSlim 15.6in (15Z90ST)

The 512GB version of this 2024 update is great value, with a stunning screen, light weight and slim design

SCORE ★★★★☆

PRICE 512GB, £1,000 (£1,200 inc VAT)
from costco.co.uk

Sometimes it pays to shop around. As we went to press, Currys was selling the 16GB/1TB version of this laptop for £1,600, and the 32GB/2TB model for £1,800. But Costco – yes, Costco – is selling the 32GB/512GB version for £1,200, at which point most of my criticisms of this laptop melt away. One of which being that I couldn't find my test model – 32GB/1TB – for sale anywhere.

Luckily, 512GB of storage isn't a disaster. If you want more, whip off the bottom to access one of the two M.2 2280 slots; four crosshead screws sit under rubber feet, with a further three hidden under annoying adhesive covers. You can't upgrade the RAM or Intel Wi-Fi 6E chip, however, as these are integrated onto the motherboard.

There are many good things about this laptop. Top of that list is the weight, with it officially weighing 990g and my unit tipping the *PC Pro* scales at 999g. Stunningly light for a laptop that crams in a 15.6in screen.

That's the second wonder, for this is a top-quality OLED panel. Not only do whites look fantastic, with a colour temperature of 6477K almost bang on the 6500K target, but colour accuracy is superb (0.42 average Delta E) and it covers 99% of the DCI-P3 gamut. Colours are dazzling. There's even HDR500 support, with the promise of 500cd/m² peaks in HDR content, but the 404cd/m² max I measured in SDR tests is more than punchy enough for viewing in all conditions. LG's excellent app allows you to take finer control over colour, too, and select whether you want to prioritise speed over low fan noise.

Finally, there's the physical design, as despite living up to its SuperSlim name at 10.9mm it's very well built. While I wouldn't chuck it around – the lid is flexible and I'd worry about bashing it too hard – it passed seven of the MIL-STD 810H tests, and the "nano carbon and magnesium" chassis is sturdy. It even feels nice to the touch, while the matte finish means fingerprints aren't a problem. Add a classy deep blue finish and LG gets a five-star rating for the laptop's design.

You're never going to fit deep-travel keys into a laptop this slim, but I was happy typing on the spacious keyboard. There's a number pad, too, while the cursor keys are separated. The Enter key is single height and there's function doubling, but I can live with both. The trackpad is a fraction small at 110 x 70mm, but it's covered with glass for a smooth feel and is suitably responsive. My final plus is that the speakers are solid inclusions with lots of detail and even some bass.

Onto the weaknesses. One is almost inevitable for a laptop this slim, which is that LG doesn't make the most of Intel's Core Ultra 155H chip. I dug out my results for the Asus Zenbook 14 OLED (*see issue 359, p58*) and LG gram Pro 16 (*see issue 361, p60*), which also use the 155H, and both outscored the SuperSlim in multicore tests; I would hope for around 12,200 in Geekbench 6 rather than 11,455, and around 600 in Cinebench 2024 rather than 406. That carried through to games, with a 27fps average in *Shadow of the Tomb Raider* at 1080p High compared to 33fps from the Zenbook.

While I do love the screen, a higher resolution than 1,920 x 1,080 would be welcome. In general it looks sharp, but there are times when I wanted more detail – such as spreadsheet work – and for a premium laptop it's reasonable to expect 1440p and a 120Hz rather than 60Hz refresh rate. And a touchscreen, which is lacking here. The other surprise was how mediocre the webcam is, with over-saturated reds and a lack of detail.

I'm more forgiving about the lack of USB-A ports, which is easy enough to solve with a port replicator, and the two USB-C 4 ports on the left also support Thunderbolt. The right-side USB-C port is slower (10Gbits/sec), with only a 3.5mm jack for company. So no HDMI, no SD card slot. And the Intel Wi-Fi 6E card is a solid rather than exceptional inclusion.

I've deliberately left battery life to last, as you can interpret this in two ways. A life of 14 hours is historically strong for a sub-1kg 15.6in OLED laptop, but the new generation of processors – whether Intel's Core Ultra 200V chips or Qualcomm's – have reset my expectations. If I bought this laptop, I suspect I would still be chucking a charger into my bag (and LG's supplied charger is bulkier than it should be).

All of which means that I'm tempted to wait until LG updates its SuperSlim range with Intel's next-gen chips, which will probably happen in 2025. That should bring a boost in battery life and a nudge up in performance, and with any luck LG might upgrade the webcam, too. But if you're looking for a slender 15.6in laptop that's so light you'll barely notice it in a bag, the new LG gram SuperSlim is a fine choice at the lower, Costco price. **TIM DANTON**

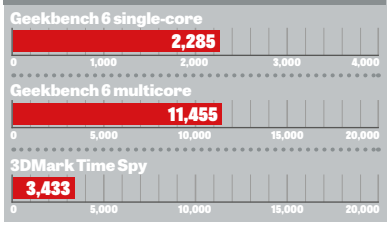
ABOVE Whites are bright and colours dazzling on the superb 15.6in OLED screen

"My unit tipped the *PC Pro* scales at 999g. Stunningly light for a laptop that crams in a 15.6in screen"

SPECIFICATIONS

16-core (6 P-cores, 8 E-cores, 2 LPE-cores) Intel Core Ultra 7 155H processor • Intel integrated Arc graphics • 32GB LPDDR5X-7467 RAM • 15.6in 60Hz OLED touchscreen, 1,920 x 1,080 resolution • 512GB M.2 PCI-E Gen4 SSD (1TB tested) • Wi-Fi 6E • Bluetooth 5.3 • 1080p IR webcam • 2 x Thunderbolt 4/USB-C 4 • USB-C 3.2 Gen 2 • 3.5mm combo jack • 60Wh battery • Windows 11 Home • 356 x 227 x 10.9mm (WDH) • 1kg • 1yr RTB warranty

BENCHMARKS



BATTERY LIFE

BELOW The incredibly slim chassis leaves no room for USB-A ports

AMD Ryzen 7 9800X3D and Intel Core Ultra 200K series

AMD's gaming chip is the clear winner of this battle, but don't write off the 200K series just yet

9800X3D SCORE ★★★★★
245K SCORE ★★★½☆
265K SCORE ★★★★☆
285K SCORE ★★★★☆

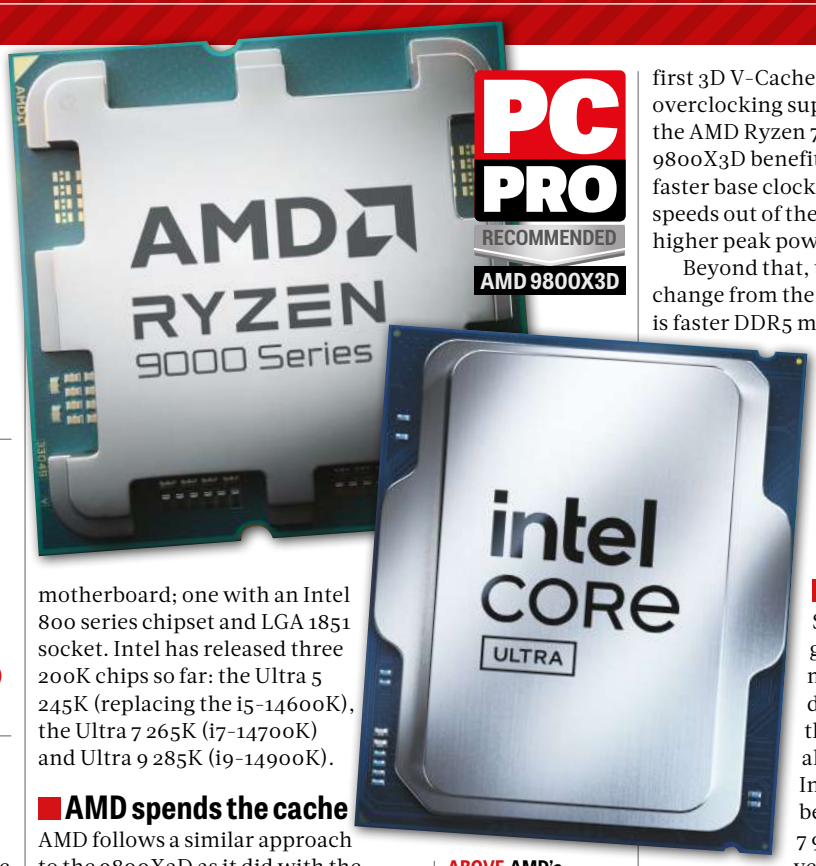
PRICE 9800X3D, £392 (£470 inc VAT), 245K £242 (£290 inc VAT); 265K, £317 (£380 inc VAT); 285K, £475 (£570 inc VAT) from scan.co.uk

The eternal battle for best processor goes on, and this month we test the latest salvos from AMD and Intel. But in truth these are very different chips. The Ryzen 7 9800X3D is an out-and-out gaming processor, while Intel's Core Ultra 200K series (codenamed Arrow Lake) are all-rounders. In particular, they're the first x86 desktop CPUs to include a neural processing unit (NPU).

Intel's 200K series have more in common with Intel's first generation Core Ultra processors for laptops than the 14th generation Core chips (such as the i7-14700K) they replace, as they're based on the same Lion Cove P-cores and Skymont E-cores. Here, though, the reins are off in terms of power supply, so you get higher boost clocks and less throttling. The thermal design power is essentially unchanged from the 14th-generation Core processors, but they do have a 5°C higher TjMax, so the chips won't start to throttle until they hit 105°C. (Tjunction max is the maximum thermal junction temperature that a processor can hit before it lowers performance to prevent overheating.)

The 200K also has the same Intel NPU as the first-gen Core Ultra laptop chips, rated at 13 TOPS. So no Copilot+ PC support here, as that requires 40 TOPS. It also includes the same Intel Arc Alchemist integrated GPU with four Xe cores (including four ray tracing cores) as its laptop cousin.

The maximum amount of RAM is unchanged at 192GB, but the Core Ultra chips don't support DDR4 RAM. Instead, they only support faster DDR5 memory up to 6,400MT/sec (see the ThinkPad P1 review on p54 for more on MT/sec). It should be no surprise that this also means you need a new motherboard; one with an Intel 800 series chipset and LGA 1851 socket. Intel has released three 200K chips so far: the Ultra 5 245K (replacing the i5-14600K), the Ultra 7 265K (i7-14700K) and Ultra 9 285K (i9-14900K).



PC PRO RECOMMENDED AMD 9800X3D

ABOVE AMD's 9800X3D beats Intel's 200K series chips, especially in games

AMD spends the cache

AMD follows a similar approach to the 9800X3D as it did with the 7800X3D. It has the same 8-core/16-thread setup as the AMD Ryzen 7 9700X, but with an additional 64MB L3 cache to take the total to 96MB.

In the first iteration of 3D V-Cache, as AMD calls it, the extra die was stacked on top of the main processing cores, but in this second generation the extra cache die is underneath the main die, leaving the main processing cores free to directly interface with the CPU cooler.

This is a big deal, as the processing cores are where all the heat is being generated, so having an extra layer of silicon between it and the CPU cooler had many implications for what the 7800X3D could do. Thermals had to be carefully managed, so clock speeds were kept in check and there was no ability to overclock the chip.

By moving the 3D V-Cache die underneath the main processor core complex, the thermal restraints around clock speeds and voltage no longer apply, so the 9800X3D is the first 3D V-Cache chip to feature full overclocking support. Compared to the AMD Ryzen 7 7800X3D, then, the 9800X3D benefits from noticeably faster base clock and boost clock speeds out of the box, along with far higher peak power demands.

Beyond that, the only major change from the previous generation is faster DDR5 memory support, from 5,200MHz with the 7800X3D to 5,600MHz with the 9800X3D. Both chips support AMD EXPO overclocking for even faster memory speeds.

Speed test

So AMD talks a good game, but what really matters is whether it delivers. And thankfully it does, albeit not universally. In the synthetic benchmarks, the Ryzen 7 9800X3D showed very strong single-core performance on a par with the rest of the Ryzen 9000-series lineup. The Ryzen 7 7800X3D, meanwhile, lags behind its Ryzen 7000 siblings due to the need to control thermals by limiting clock speeds. The Ryzen 9800X3D doesn't have this problem. Likewise, its multicore performance is also unconstrained, running ahead of the Ryzen 7 9700X across the board.

"Here, the reins are off in terms of power supply, so you get higher boost clocks and less throttling"

It's a more nuanced story for Intel's chips. Take the Ultra 9 185K. In Geekbench 6, the Core Ultra 9 outperforms the 14900K in single-core performance by about 8%, only to lose out by about the same in Cinebench R23's single-core benchmark. Meanwhile, in Cinebench R23's multicore test, the Ultra 9 285K comes in about 12% faster than the 14900K and is essentially tied with the AMD Ryzen 9 9950X.

In terms of average creative performance, the Core Ultra 9 285K does slightly better than the 14900K but slightly worse than the Ryzen 9 9950X. The Core Ultra 5 245K, meanwhile, does slightly worse on average than the Core i5-14600K, but comes out nearly 23% better than the Ryzen 5 9600X (we don't show its scores here due to a lack of space).

Generally, creatives need not concern themselves with the 9800X3D – though there is one exception. If you're a photographer or graphic designer who does a lot of work in Photoshop or its alternatives, the 9800X3D's extra cache is going to be a serious benefit for your workflows,

KEY SPECIFICATIONS

	Ryzen 7 9800X3D	Core Ultra 5 245K	Core Ultra 7 265K	Core Ultra 9 285K
Core count	8P	6P + 8E	8P + 12E	8P + 16E
Thread count	16	14	20	24
P-core base clock	4.7GHz	4.2GHz	3.9GHz	3.7GHz
P-core boost clock	5.2GHz	5.2GHz	5.5GHz	5.7GHz
E-core base clock	N/A	3.6GHz	3.3GHz	3.2GHz
E-core boost clock	N/A	4.6GHz	4.6GHz	4.6GHz
L3 cache	96MB	24MB	30MB	40MB
NPU	N/A	13 TOPS	13 TOPS	13 TOPS
Base power	120W	125W	125W	125W
Turbo power	Not stated	159W	250W	250W

beating even the Intel Core i9-14900K in PugetBench for Adobe Photoshop by a few hundred points.

Game on (the 9800X3D)

It's gaming where the 9800X3D really shows off, with one caveat. In games where the main CPU bottleneck is game logic, the extra cache isn't necessarily going to help your game performance. You just need the fastest clocks possible. That's why Intel's previous-generation (and even current-gen) chips have an advantage in games such as *Returnal*, where complex bullet and geometry physics are the main CPU workload. Or *Total War: Warhammer III*, where a lot of individual actors need to have their logic calculated quickly.

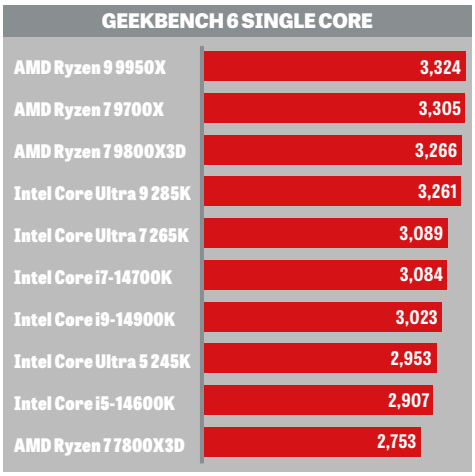
Where 3D V-Cache really benefits gaming is when there's data being communicated from the CPU to the GPU, such as texture files or model geometry, and that additional cache memory can retain these smaller (but not tiny) files in the fastest possible memory that can hold it. Games such as *F1 2023* and *Tiny Tina's Wonderland* benefitted mightily from the extra available cache. In the case of the former, the Ryzen 9800X3D just wallops the Intel Core i9-14900K, and in the case of the latter, runs a very close second to it.

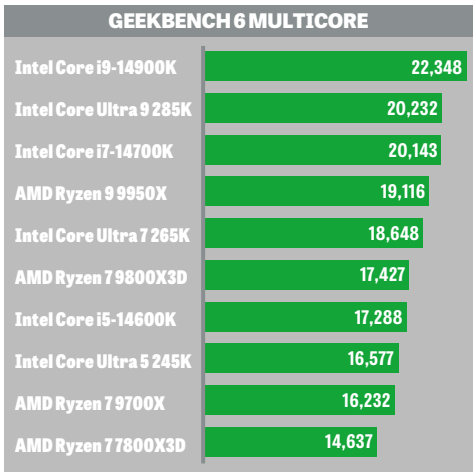
With performance that comes in neck and neck with the best Intel processors in gaming workloads, the Ryzen 7 9800X3D would already be an incredible chip. But I can't get over the fact that the 9800X3D can do this with only 53% of the power of the Core i9-14900K. Add to that the Ryzen 7 9800X3D's impressive single- and multicore speed, surprisingly great Photoshop performance, and gen-on-gen gains at very little monetary cost, and the Ryzen 7 9800X3D is easily one of the best AMD processors ever made.

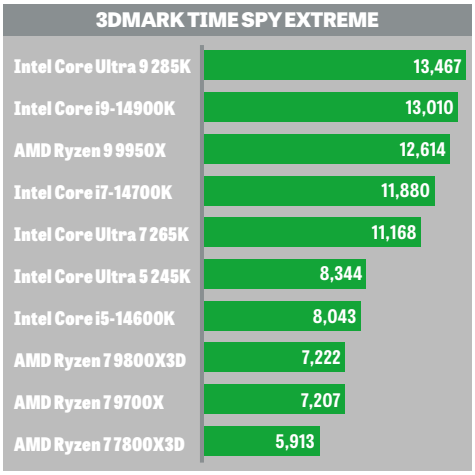
It's less good news for Intel's chips. They're slower than the processors they replace in too many areas, with the only obvious benefit being their lower power draw (an area where AMD clearly wins). To rub salt into the wound, you'll need a new motherboard to house the Core Ultra chips, and right now even a stripped-down offering costs £200. The performance and efficiency just don't make these compelling purchases on their own.

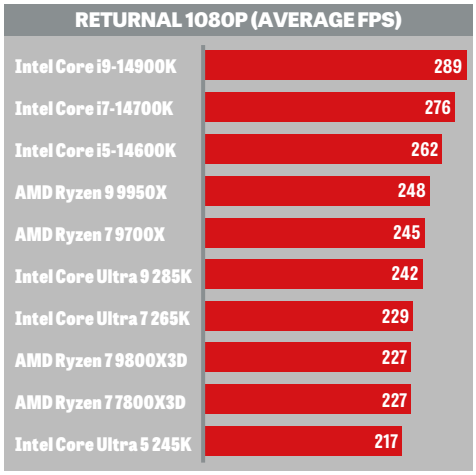
This premium means prebuilt PCs based around the Core 5 Ultra won't make sense for a while (too much of the price is swallowed by the board), but Core 7 and Core 9 Ultra systems may make sense depending on your usage.

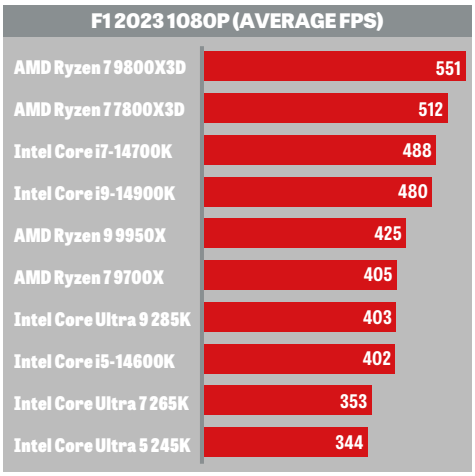
But let's not mince words. Arrow Lake has missed the target, while the 9800X3D hits it bang in the middle. **JOHN LOEFFLER**

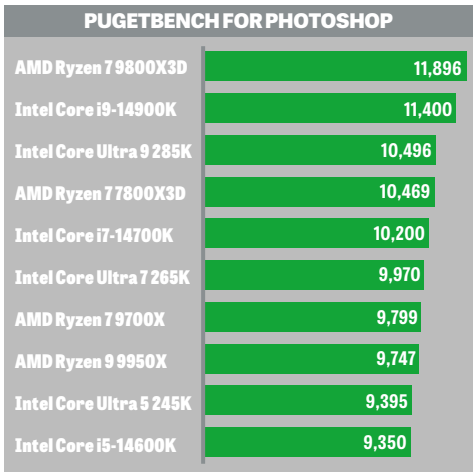

GEEKBENCH 6 SINGLE CORE
AMD Ryzen 9 9950X 3,324
AMD Ryzen 7 9700X 3,305
AMD Ryzen 7 9800X3D 3,266
Intel Core Ultra 9 285K 3,261
Intel Core Ultra 7 265K 3,089
Intel Core i7-14700K 3,084
Intel Core i9-14900K 3,023
Intel Core Ultra 5 245K 2,953
Intel Core i5-14600K 2,907
AMD Ryzen 7 7800X3D 2,753
HIGHER IS BETTER

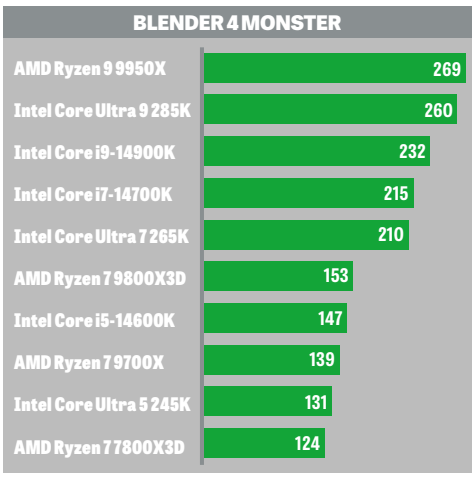

GEEKBENCH 6 MULTICORE
Intel Core i9-14900K 22,348
Intel Core Ultra 9 285K 20,232
Intel Core i7-14700K 20,143
AMD Ryzen 9 9950X 19,116
Intel Core Ultra 7 265K 18,648
AMD Ryzen 7 9800X3D 17,427
Intel Core i5-14600K 17,288
Intel Core Ultra 5 245K 16,577
AMD Ryzen 7 9700X 16,232
AMD Ryzen 7 7800X3D 14,637
HIGHER IS BETTER

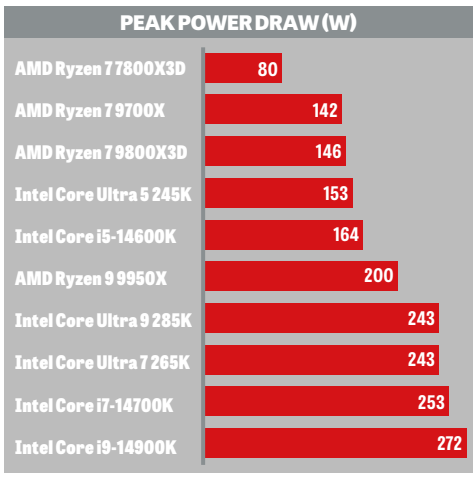

3DMARK TIME SPY EXTREME
Intel Core Ultra 9 285K 13,467
Intel Core i9-14900K 13,010
AMD Ryzen 9 9950X 12,614
Intel Core i7-14700K 11,880
Intel Core Ultra 7 265K 11,168
Intel Core Ultra 5 245K 8,344
Intel Core i5-14600K 8,043
AMD Ryzen 7 9800X3D 7,222
AMD Ryzen 7 9700X 7,207
AMD Ryzen 7 7800X3D 5,913
HIGHER IS BETTER


RETURNAL 1080P (AVERAGE FPS)
Intel Core i9-14900K 289
Intel Core i7-14700K 276
Intel Core i5-14600K 262
AMD Ryzen 9 9950X 248
AMD Ryzen 7 9700X 245
Intel Core Ultra 9 285K 242
Intel Core Ultra 7 265K 229
AMD Ryzen 7 9800X3D 227
AMD Ryzen 7 7800X3D 227
Intel Core Ultra 5 245K 217
HIGHER IS BETTER


F1 2023 1080P (AVERAGE FPS)
AMD Ryzen 7 9800X3D 551
AMD Ryzen 7 7800X3D 512
Intel Core i7-14700K 488
Intel Core i9-14900K 480
AMD Ryzen 9 9950X 425
AMD Ryzen 7 9700X 405
Intel Core Ultra 9 285K 403
Intel Core i5-14600K 402
Intel Core Ultra 7 265K 353
Intel Core Ultra 5 245K 344
HIGHER IS BETTER


PUGETBENCH FOR PHOTOSHOP
AMD Ryzen 7 9800X3D 11,896
Intel Core i9-14900K 11,400
Intel Core Ultra 9 285K 10,496
AMD Ryzen 7 7800X3D 10,469
Intel Core i7-14700K 10,200
Intel Core Ultra 7 265K 9,970
AMD Ryzen 7 9700X 9,799
AMD Ryzen 9 9950X 9,747
Intel Core Ultra 5 245K 9,395
Intel Core i5-14600K 9,350
HIGHER IS BETTER


BLENDER 4 MONSTER
AMD Ryzen 9 9950X 269
Intel Core Ultra 9 285K 260
Intel Core i9-14900K 232
Intel Core i7-14700K 215
Intel Core Ultra 7 265K 210
AMD Ryzen 7 9800X3D 153
Intel Core i5-14600K 147
AMD Ryzen 7 9700X 139
Intel Core Ultra 5 245K 131
AMD Ryzen 7 7800X3D 124
HIGHER IS BETTER


PEAK POWER DRAW (W)
AMD Ryzen 7 7800X3D 80
AMD Ryzen 7 9700X 142
AMD Ryzen 7 9800X3D 146
Intel Core Ultra 5 245K 153
Intel Core i5-14600K 164
AMD Ryzen 9 9950X 200
Intel Core Ultra 9 285K 243
Intel Core Ultra 7 265K 243
Intel Core i7-14700K 253
Intel Core i9-14900K 272
LOWER IS BETTER

HP Omen 35L

An elegant and quiet system packed with powerful components, but look out for discounts

SCORE ★★★★☆

PRICE As reviewed, £1,500 (£1,800 inc VAT) from hp.com

HP has an enviable track record of creating innovative and fine-looking gaming PCs. The HP Omen 45L (*see issue 333, p50*) with its dedicated "Cryo Chamber" is a case in point. The Omen 35L's chassis is ten litres smaller, as its name indicates, and uses more conventional cooling methods, but it lives up to expectations for design.

Let's start with the noise, or lack of it, in general use. While you can usually hear the fans inside gaming PCs, the Omen 35L stays almost silent even when it's put under pressure. If this is important to you, head into HP's slick Omen Gaming Hub app, which allows you to choose a Balanced or Performance Mode, and then select Quiet, Normal or Turbo fan settings. For testing purposes, I chose Performance and Turbo.

The Omen Gaming Hub is also where you set your lighting preferences, and there's no shortage of lights here. HP spreads six 120mm aRGB fans around the chassis: two visible through the tinted glass front, two at the top, one at the rear and the final one attached to the heatsink. If you like a garish cascading rainbow of colours, they're yours; I preferred an understated burnt orange. Final splashes of colour come from the supplied Kingston Fury RAM, with two DIMMs in the supplied configuration and two slots free.

HP also sells the new Omen 35L with Intel chips, but here I focus on the AMD version. The cheapest offering combines a Ryzen 8500G with 16GB of RAM and a GeForce RTX 4060 graphics card for £1,400, rising to £2,200 for a Ryzen 8700G, 32GB of RAM and 4070 Ti Super graphics. I tested the mid-range option with the 8700G, 16GB of RAM and 4070 Super graphics for £1,800. Look out for offers, though, as HP cut £200 off all those prices for Black Friday.

ABOVE **A good Omen: HP's latest gaming PC is a stylish beast**

Every configuration includes a 1TB WD Black SSD, and it's fast: 5,020MB/sec sequential reads, 3,528MB/sec writes. There's a second slot for an M.2 SSD on the motherboard, and the Wi-Fi 7 M.2 card is replaceable, too. However, despite HP's claims that this is a tool-less design, you'll need time, patience and a high-quality crosshead screwdriver to access the slots due to the muscular metal frame that keeps the graphics card in place. Likewise to fill the empty PCI-Express x1 slot. Fortunately, it's much easier to add a hard disk, with a removable caddy that does indeed require no tools.

Considering the size of the chassis, that's not much expandability, and the rat's nest of cables (skilfully hidden from view) doesn't help matters. At least HP includes an 850W power supply, so there's plenty of spare capacity from that point of view: I measured peak draw at 383W and an idle of 38W.

With an air rather than liquid cooler, perhaps it isn't surprising that HP doesn't squeeze every last morsel out of this setup in terms of speed. Despite testing in Performance Mode, it consistently trailed the PCSpecialist Torpedo R (*see issue 363, p56*), which has the same GPU, typically by around 5fps behind at 1440p and 2-3fps slower at 4K. Not that this is likely to be the difference between playable and unplayable results. For example, at the highest quality settings and 4K, the Omen 35L averaged 134fps in *Shadow of the Tomb Raider*, 98fps in *Dirt 5* and 51fps in *Cyberpunk 2077*. Dropping to 1440p, those averages were 168fps, 154fps and 106fps respectively.

This isn't a system for overclockers, being based around an 8700G chip rather than, say, a 9700X. But it's still fast, scoring 8,758 in PCMark 10 (the Torpedo was again stronger at 8,961) and 946 in Cinebench 2024's multicore test, so there are few tasks at which it won't meet expectations.

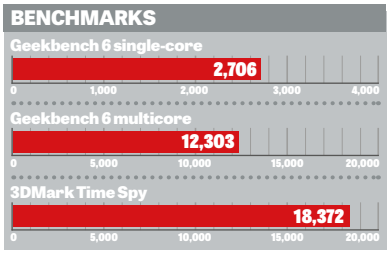
"While you can usually hear the fans of most gaming PCs, the Omen 35L stays almost silent even when it's put under pressure"

There's also a chicness to the HP Omen 35L that British rivals can't match. It even looks attractive from the rear, with a simple and well labelled backplate. This comes at some cost to connectivity: the RJ45 port supports 1GbE not 2.5GbE, the two USB-C ports (one rear, one front) peak at 10Gbits/sec and none of the eight USB-A ports (six rear, two front) goes above 5Gbits/sec. The warranty is a miserly single year of return-to-base cover, while every UK-based PC company was rated higher for customer support in our 2024 survey (*see issue 363, p26*). The final consideration is that Nvidia is, according to industry rumours, set to announce RTX 50 series cards in January.

All of which means that I wouldn't recommend the Omen 35L at its full price. With a £200 discount, however, it becomes a far more attractive deal. **TIM DANTON**

BELOW **Six aRGB fans provide splashes of colour around the Omen 35L's chassis**

BENCHMARKS



SPECIFICATIONS

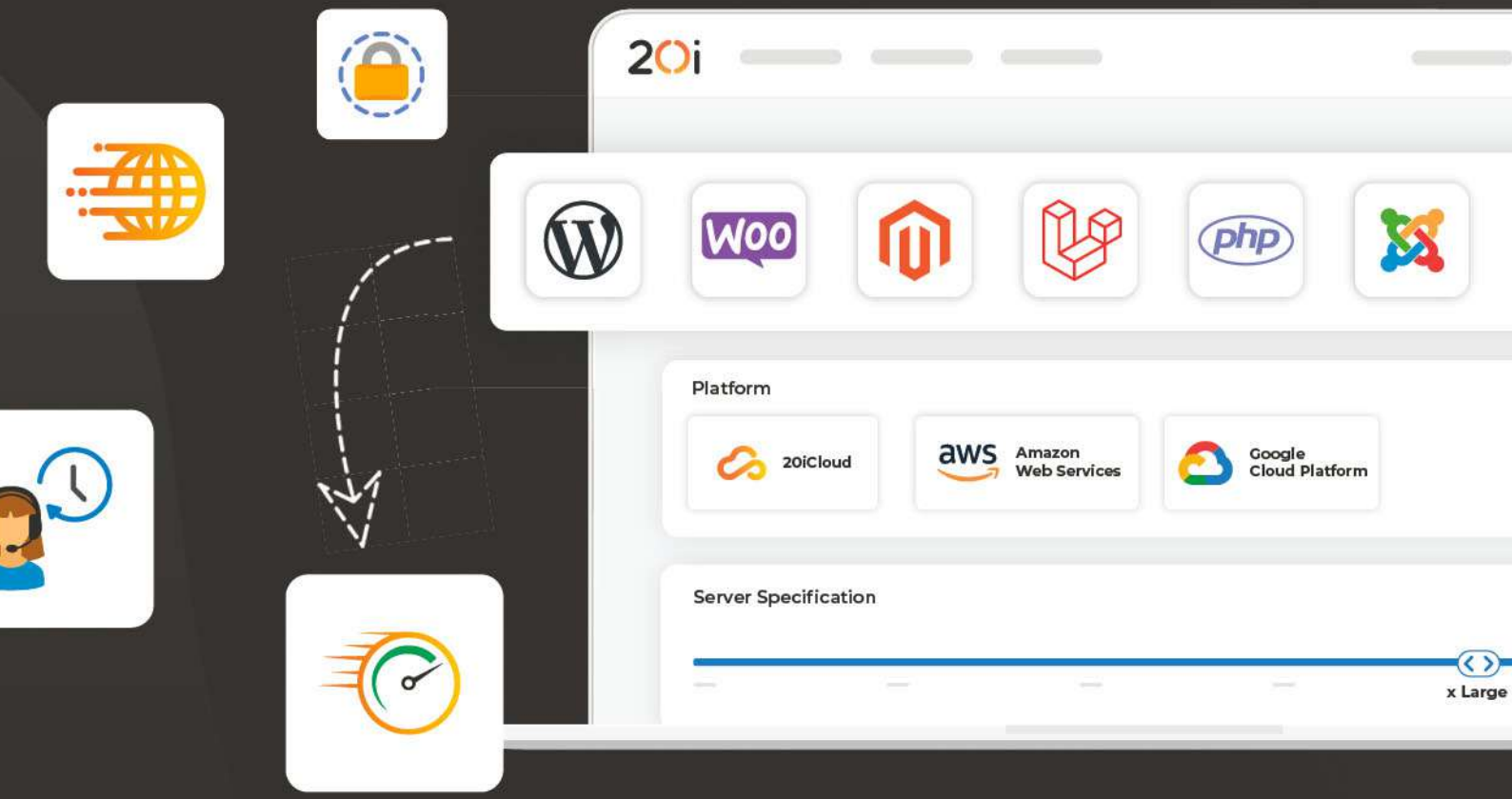
8-core AMD Ryzen 7 8700G processor • HP (AMD B650) motherboard • 16GB Kingston Fury DDR5-5200 RAM • 12GB Nvidia GeForce RTX 4070 Super graphics • air cooler • 1TB WD Black PCI-E Gen 4 SSD • Wi-Fi 7 • Bluetooth 5.4 • HP Omen 35L chassis • 850W 80 Plus Gold PSU • Windows 11 Home • 210 x 407 x 409mm (WDH) • 1yr RTB warranty • power: 38W idle, 383W peak

20i

PC PRO TECHNOLOGY EXCELLENCE AWARDS 2024

Best Web Host

PC Pro Awards 2024



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CyberPowerPC Ultra BFD R57

An Nvidia RTX 4060 PC that CyberPowerPC put together for Black Friday, and value is its biggest selling point

SCORE ★★★★☆

PRICE £666 (£799 inc VAT)
from tinyurl.com/364cyber

PC PRO RECOMMENDED

Everyone loves a Black Friday bargain, and that's what CyberPowerPC put together for its followers. It sent *PC Pro* a sample too, as even though Black Friday has passed, the PC is still available.

It's certainly one of the cheapest routes I've seen to a GeForce RTX 4060 gaming system, and with a mechanical gaming keyboard thrown in it looks even better value when compared to the £999 PCSpecialist PC opposite. Admittedly the keyboard is basic, as reflected by its £50 retail price, but you get RGB lighting (not addressable) and it's a true mechanical keyboard, with noise to match.

I initially thought I would be complaining about fan noise whenever I used the PC, but the clunky MSI software gives you just enough control over fan speed to prevent this being annoying. Unlike the HP Omen 35L (*see p60*), there's always a faint whirr, but switch to Balanced or Quiet modes and it won't be irritating.

This made little difference to frame rates in my experience, as the fans kick in regardless as soon as games load up, and in general I found this system to be just as fast as the PCSpecialist – despite the latter having a more recent and faster Ryzen processor. Across all games and all resolutions, the difference was typically 1-2fps, so within the margin of error. The only time the Ryzen 7 5700X slowed it down was at 1080p in *Shadow of the Tomb Raider*, but who really cares about 174fps at highest settings compared to 163fps?

As with any RTX 4060 system, it's most comfortable at 1080p or 1440p. At the latter, and with the highest settings, *Shadow of the Tomb Raider* averaged 124fps, *Dirt 5* 79fps and *Cyberpunk 2077* 58fps; at the former, those results were 163fps, 101fps and 96fps. And it didn't consume a huge amount of power while doing so, peaking at 248W compared to its idle figure of 48W.

The 5700X remains a fast processor despite being two years old and based on Zen 3 architecture, but it's true that the PCSpecialist's 9600X is superior. Just compare their Geekbench results, where the CyberPowerPC was a distant second, or in PCMark 10 with a result of 7,469 to 9,006. That's nothing to do with the storage, as this system's 1TB WD Blue SN580 drive sustained write speeds of over 4,000MB/sec while the PCSpecialist stayed below 3,000MB/sec.

CyberPowerPC chooses MSI's basic B550M Pro-VDH motherboard, which looks small when placed in a full-sized mid-tower chassis such as this. The three 120mm fans at the front and the single rear 120mm fan are all aRGB, but this isn't a feast for the eyes. You may want to add your own decorations.

The motherboard doesn't include Wi-Fi, so CyberPowerPC includes USB adapters for both Bluetooth 5 and Wi-Fi 5 in the box. It's a thoughtful touch, but they naturally can't match the range of an integrated chip with external aerials. Also note that there's no USB-C here, even though the motherboard includes a header.

The good news is that there's so much space inside the chassis that it's easy to work in, whether that's accessing the two PCI-E x1 slots, the two empty DIMM sockets or the spare M.2 Gen3 SSD slot. You can add more storage if you remove the right-hand side of the Eluna chassis – a CyberPowerPC own brand unit (CyberPowerPC UK is the British wing of an American company, with all the extra resources this brings). This reveals two caddies for 3.5in hard disks and one mounting plate for a 2.5in drive, and as the MSI board only includes four SATA ports you're getting close to capacity. Not power capacity, however, as there's a 650W InWin power supply in place. It's only rated 80+ Bronze, though.

There's no skimping on the warranty, with two years of parts and labour cover followed by three years of labour-only support. After the first year you'll need to cover the costs of sending the PC to repair at its Gateshead base, but at this price it's hard to complain. In fact, it's hard to complain at all. Yes, there are obvious signs that this PC has been produced to hit a price, but none of those choices affect its gaming prowess. If that's your priority, and this is your budget, it's a great choice. **TIM DANTON**

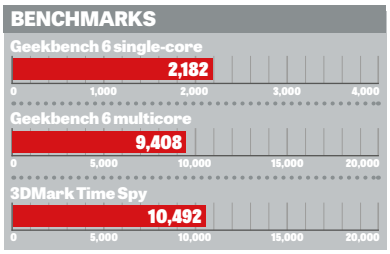
ABOVE The Ultra BFD R57 is a bargain way to get RTX 4060 graphics

LEFT There are no USB-C ports here, including even on the top of the chassis

"There are obvious signs that this PC has been produced to hit a price, but none of those choices affects its gaming prowess"

BELOW The fans add colour and noise, but both can be controlled

BENCHMARKS



SPECIFICATIONS

8-core AMD Ryzen 7 5700X processor • MSI B550M Pro-VDH motherboard • 16GB DDR4-3200 Kingston Fury Beast RAM • 8GB MSI GeForce RTX 4060 graphics • Cooler Master Hyper 212 Spectrum V2 air cooler • 1TB WD Blue SN580 PCI-E Gen4 SSD • CyberPowerPC Eluna chassis • 650W InWin B65E PSU • Windows 11 Home • 216 x 455 x 490mm (WDH) • USB Bluetooth 5 adapter • USB Wi-Fi 5 adapter • CyberPower Skorpion K2 RGB keyboard • 2yr parts and labour warranty (first year C&R) plus 3yr labour-only RTB • power, 48W idle, 248W peak

PCSpecialist Zircon Supreme R

An understated PC in terms of looks and noise, but when you need to turn on the power it's ready

SCORE ★★★★☆

PRICE £833 (£999 inc VAT)
from pcspecialist.co.uk/reviews

At first glance it may seem absurd that the PCSpecialist Zircon Supreme R is worth considering when it offers precisely the same RTX 4060 graphics card as the CyberPowerPC system opposite. After all, it's £200 more expensive and delivers nigh-on identical frame rates in games.

And that fact is inarguable. One minor difference is that PCSpecialist opts for a Zotac graphics card, but as this shares the compact dual-fan design of the CyberPowerPC's MSI card they proved almost inseparable in our tests. So the same truth holds for both PCs: if you want to play challenging games at over 100fps then you'll need to drop to 1080p, but most gamers will be happy with its 1440p performance. At high settings, we saw 133fps in *Shadow of the Tomb Raider*, 97fps in *Dirt 5* and 83fps in *Cyberpunk 2077*.

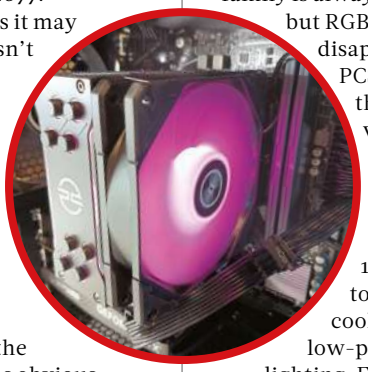
But, paradoxical as it may sound, a gaming PC isn't just about playing games. PCSpecialist spends its extra budget on one key component: a Ryzen 5 9600X processor. Buy a boxed version and this costs £230 to the £160 of the Ryzen 7 5700X in the CyberPowerPC, and the difference in class was obvious throughout our tests.

Take Geekbench 6, where the 9600X produced a superb 3,230 in the single-core section. This emphasises the power of AMD's Zen 5 architecture, while the 5700X is stuck on Zen 3. Despite having eight cores to the six of the 9600X, the 5700X again trailed in the multicore section of Geekbench, with 9,408 to 13,681. We saw the same pattern in Cinebench 2024's CPU tests, with 928 in the multicore section versus 757.

Some of the Zircon's advantage stems from using DDR5 memory rather than DDR4, which is another reason why this PC is more expensive. Corsair's Vengeance family is always a fine choice, but RGB lovers will be disappointed that PCSpecialist chose the plain Black version. In fact, aside from the three dominant 120mm fans at the front, and one 100mm fan attached to the PCS FrostFlow cooler, it has adopted a low-profile approach to lighting. Fire up Asus' Armoury Crate software if you wish to customise the RGB patterns, though, as it's all addressable.

The chassis is a solid rather than exceptional choice. It's one of PCSpecialist's own-brand models, with a mesh metal front through which the RGB fans shine, and though it doesn't exude style in the same way as, say, the HP Omen 35L (*see p60*), it's a reasonable choice for a £999 system. It helps that the tempered glass side stretches all the way down and across, which provides an unimpeded view to the excellent cabling.

ABOVE The Zircon Supreme R has a more powerful CPU than the CyberPowerPC



LEFT A PCS FrostFlow air cooler keeps things cool and quiet

BELOW Three fans at the front bring a splash of colour

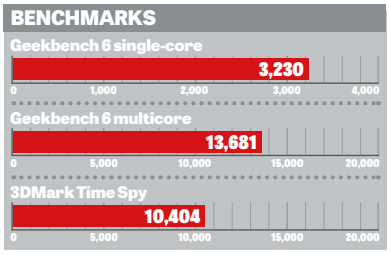
Naturally, things aren't so tidy if you remove the metal right-hand panel, which you'll need to do if you want to add a 3.5in drive. There's one toolless caddy, and space above to screw in two 2.5in drives. But that's your only route for adding more, as the Asus Prime A620M-K motherboard only includes one M.2 SSD slot, which PCSpecialist fills with a mid-range 1TB SolidIGM P41+ drive; this returned 3,971MB/sec sustained reads and 2,949MB/sec writes in CrystalDiskMark.

It quickly became apparent that this isn't a board for keen upgraders. Both DIMM sockets are full, and there's only one PCI-Express x1 slot available. Nor is the backplate a thing of wonder, with six USB-A ports, a trio of audio jacks and a 1GbE RJ45 connector the only inhabitants. So, just like the CyberPowerPC, there's no USB-C to be found here at all (all three USB ports on the front of the chassis are USB-A).

"If you want to play games at over 100fps you'll need to drop to 1080p, but most gamers will be happy with its 1440p performance"

The Zircon has one final attraction, and that's how quietly it runs. Not as quiet as the often silent HP Omen 35L, but enough that I only noticed fan noise during benchmarking. Add a three-year warranty backed up by PCSpecialist's excellent results for customer service and reliability (*see issue 363, p28*), and it should be obvious that there are reasons to buy the PCSpecialist Zircon Supreme R beyond raw frame rates. **TIM DANTON**

BENCHMARKS



SPECIFICATIONS

6-core AMD Ryzen 5 9600X processor • Asus Prime A620M-K motherboard • 16GB Corsair Vengeance DDR5-5200 RAM • 8GB Nvidia GeForce RTX 4060 graphics • PCS FrostFlow 100 aRGB v3 air cooler • 1TB SolidIGM P41+ M.2 PCI-E Gen4 SSD • PCS Spectrum II Compact aRGB chassis • 650W Corsair RM PSU • Windows 11 Home • 208 x 458 x 400mm (WDH) • 3yr warranty (6 month C&R, 1yr RTB parts & labour, 2yr labour only) • power: 58W idle, 276W peak

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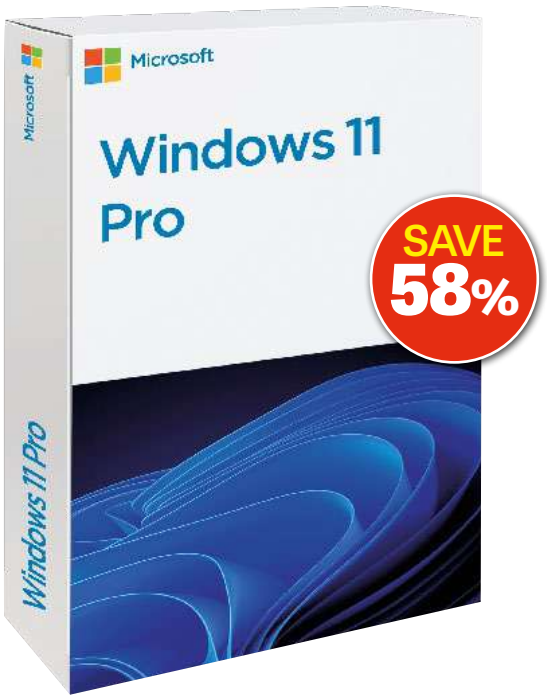


Want to upgrade from Windows 11 Home to Windows 11 Pro? Or perhaps you're looking to move up from Windows 10 Home?

Whatever your motives, a Windows 11 Professional upgrade licence is a great choice. The first reason is simple: price. Microsoft charges £119.99 for a retail licence of Windows 11 Home, a staggering £219.99 for Windows 11 Pro, and £119.99 for its own upgrade licence from 11 Home to Pro. By choosing this licence – and avoiding the many dubious sources of licences for sale online – you cut that price substantially.

Note that the upgrade only works from an *activated* copy of Windows 11 Home.

ALSO CONSIDER Windows 11 Pro OEM licence for £79.99 **SAVE** 64%

Office 2024 Home for £109.99

tinyurl.com/office2024home

Don't fancy paying Microsoft £59.99 per year to subscribe to Office? But you do want the latest copies of Word, Excel and PowerPoint? Then consider this 1-PC lifetime licence of the latest release of Microsoft Office, which has just gone on sale as a standalone version (perhaps for the last time).

New Word 2024 features include protecting untrusted documents (any you've just downloaded, say) in a sandbox, SmartArt graphics to help build impressive diagrams and the ability to edit pictures from within Word. Excel 2024 is faster than ever while gaining new functions and all the brilliant visualisation tools – such as Sparklines – that recent updates have added. And PowerPoint 2024 lets you record live camera content straight to your slide, export your slides as a video and add closed captions for audio and video.

You don't get Outlook in this package, but you do get a lifetime licence for one person to use on a single PC or Mac.

ALSO CONSIDER Office Home & Business 2024 for £229.99 **SAVE** 8%

Norton 360 Premium for £19.99 (10 devices for two years)

tinyurl.com/norton360premium

We've negotiated a killer deal with Norton. No subscriptions, just a one-off bargain price of £19.99 compared to the regular £179.99. That buys you two years of cover from the powerful Norton Security suite across ten devices.

And because it's the Premium version, you get a host of extra tools. There's 75GB of cloud storage for secure backups, plus the full version of Norton Secure VPN, both to protect your identity and provide a way of watching British TV when you're abroad.

Norton Parental Control provides tools to see exactly what your kids are up to on their various devices, and you also get GPS location monitoring for Android and iOS.

To round things off, Norton Password Manager generates and stores passwords across all your devices, while SafeCam for PC stops cybercriminals attempting to take photos with your webcam without your knowledge.

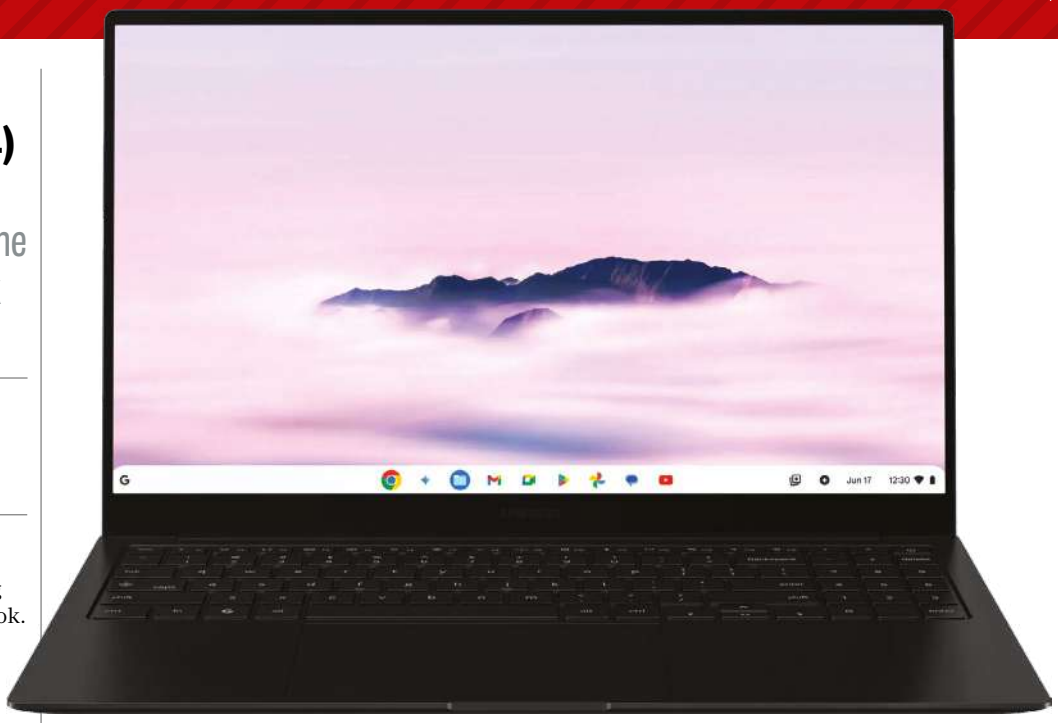
ALSO CONSIDER Acronis True Image 2025 Advanced for £29.99 **SAVE** 40%

Samsung Galaxy Chromebook Plus (2024)

Sleek, stylish and packing a superb OLED panel, this is the best high-end Chromebook since the Pixelbook

SCORE ★★★★★

PRICE Core 5, £624 (£749 inc VAT)
from samsung.com

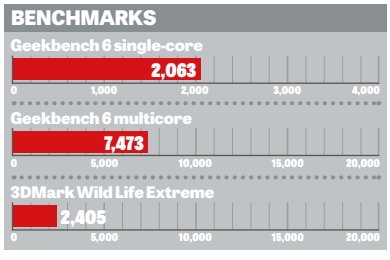


Ever since Google retired the Pixelbook, we've been waiting for a truly luxurious Chromebook. Well, that wait is over: the Galaxy Chromebook Plus not only features a 15.6in AMOLED laptop and premium, slimline design, but it also packs enough power to keep Chrome OS happy for years.

The design will grab you from the moment you lift it from the box. It's supermodel-slim at 11.8mm, and Samsung doubles down on this by giving the metal chassis an attractive matte, dark blue finish. Add a weight of 1.2kg and you'll struggle to find anyone who doesn't love the look, feel and weight of this laptop.

Samsung then thoroughly spoils us with an AMOLED panel. My unit reached a peak brightness of exactly 400cd/m² (the typical brightness Samsung claims), which is plenty for every lighting condition you'll encounter other than blazing sunlight. The glossy panel doesn't help. But AMOLED's perfect contrast ensures you can still make out what's going on, while its 99% coverage of the DCI-P3 space means films look great. Whites are top-notch, too.

There are three negatives: one is that this isn't a touchscreen, which rules out numerous Android apps that would otherwise be usable. It also hinders navigation: Google sticks with its hidden scroll bars, which only appear when you hover over them with a mouse, which is why I like to have a touchscreen on a Chromebook.



Another is a resolution of 1,920 x 1,080 rather than, say, 2,560 x 1,440. Text and images still look sharp, though, and it isn't such a problem in Chrome OS as it is in Windows because you're more likely to focus on one task at a time. Finally, don't expect top colour accuracy, with an average Delta E of 2.47 in our tests.

You can buy the Chromebook Plus with a Core 3 100U for £649 or a Core 5 120U for £749, and I tested the latter. Both will be nippy, but I'd be tempted to pay the extra: the Core 5 scored 2,063 and 7,473 in the Geekbench 6 single-core and multicore tests, while a Core 3 system returned 1,902 and 6,015. There was a similar difference in 3DMark Wild Life Extreme, with 2,405 (14fps) versus 1,966 (12fps). Bearing in mind that Google provides automatic updates to Chrome OS for ten years, it's worth investing in a fast processor from the off.

That assumes no hardware failures, and as usual you only get a one-year warranty here. Unpeeling the bottom panel reveals that the 8GB of memory is soldered onto the motherboard, along with every other core component. Thankfully the battery is replaceable, and with a 67Wh capacity it kept this laptop going for over 11 hours. Very creditable indeed when you consider the AMOLED panel.

You can also replace the speakers, which fall into the run-of-the-mill category. Music is bearable but the trebles drown out mids and bass. The best thing about the 1080p webcam setup is the microphone, with a blue tinge to captured video and a distinct lack of detail. As with the speakers, it's okay rather than good. Better news is that all Chromebook Plus purchases come with a year of Gemini AI, which allows you to add "studio style" effects during calls. More usefully, you benefit from Magic Editor in the Google Photos app and AI writing aids.

ABOVE The Galaxy Chromebook Plus brings a touch of luxury for a low price

PC PRO ★★★★ A-LIST

"The design will grab you from the moment you lift it from the box. It's supermodel-slim at 11.8mm"

This is a nice laptop to type on, too, with large, firm keys, a double-height Enter key and a good-sized number pad. The cursor keys are separated out, with no function doubling, which leaves a rattly space bar as my sole criticism. I also love the huge, glass-coated trackpad.

Samsung even gets connectivity right, with two USB-C ports and an HDMI output on the left, while a still useful USB-A port, microSD card slot and 3.5mm combo jack sit on the right. Wi-Fi 6E and Bluetooth 5.3 complete the set.

This laptop can't quite live up to the quality of the Pixelbook – note all my criticisms – but at £649 for the Core 3 version and £749 for this Core 5 offering (both include 8GB of RAM and 256GB of storage), it can't be knocked for value for money. It's a great advert for Chromebook Plus laptops and goes straight to the top of our A List. **TIM DANTON**

BELOW The classy blue chassis adds a touch of style

SPECIFICATIONS

10-core (2 P-cores, 8 E-cores) Intel Core 5 processor 120U • Intel Graphics • 8GB LPDDR5X RAM • 15.6in 60Hz AMOLED touch panel, 1,920 x 1,080 resolution • 256GB eUFS storage • Wi-Fi 6E • Bluetooth 5.3 • 1080p webcam • 2 x USB-C 3.2 Gen 2 • USB-A 3.2 Gen 2 • HDMI • microSD card reader • 3.5mm combo jack • 68Wh battery • Chrome OS • 355 x 226 x 11.8mm (WDH) • 1.2kg • 1yr RTB warranty

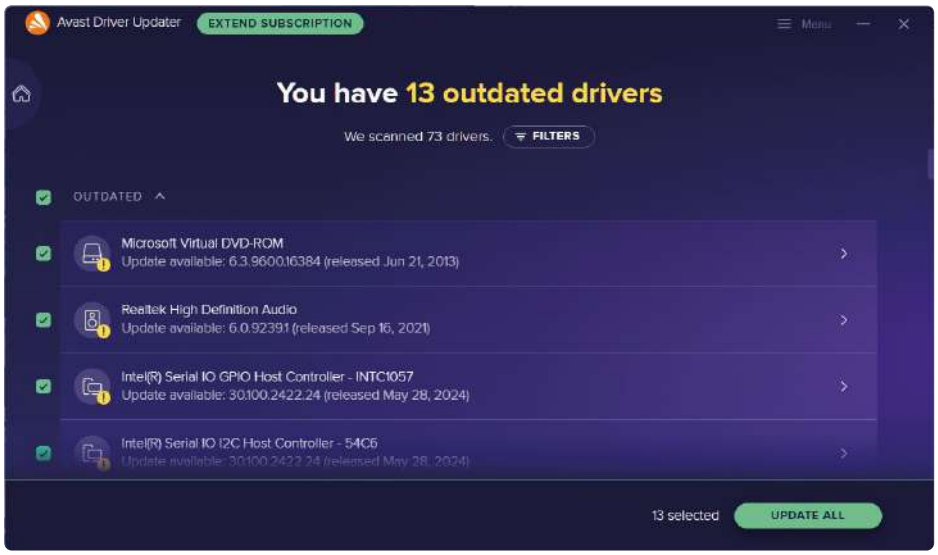
Your bonus software

Total value this month £121

We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

Avast Driver Updater 2024

One-PC, one-year licence worth £39
avast.com
REQUIRES Windows 7 or later; 50MB hard drive space; online registration


Avast Driver Updater
EXTEND SUBSCRIPTION
Menu
You have 13 outdated drivers
We scanned 73 drivers.
FILTERS
OUTDATED
Microsoft Virtual DVD-ROM
Update available: 6.3.9600.16384 (released Jun 21, 2013)
Realtek High Definition Audio
Update available: 6.0.92391 (released Sep 16, 2021)
Intel(R) Serial IO GPIO Host Controller - INTC1057
Update available: 30.100.2422.24 (released May 28, 2024)
Intel(R) Serial IO I2C Host Controller - 54C6
13 selected
UPDATE ALL

You might not give them much thought, but drivers are central to the smooth running of your computer. Every piece of hardware you install – even key internal components of your PC – requires a driver to make it work and help it communicate with the rest of your machine and the software you rely on.

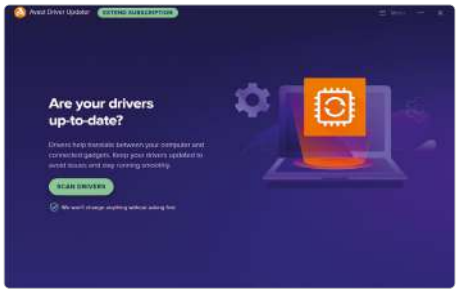
It's therefore essential that you keep your drivers up to date. The latest version might not only improve your computer's overall performance and incorporate new features and options, it could also address security issues and bugs that have been detected since older versions were released.

Unfortunately, ensuring the dozens of drivers installed on your system are kept current isn't always easy. Windows Update can help when you need to patch some drivers, but it doesn't cover everything, and neither does it always offer you the latest version of a given driver. Some companies ship utilities that will periodically check for new versions, but keeping such programs running around the clock isn't always practical, and might not be the best use of your computer's limited resources – especially if they only deliver a new driver once every few months.

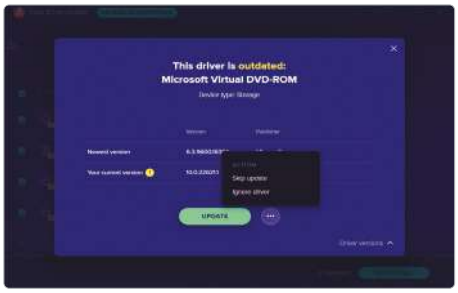
One solution is to manually visit the websites of each hardware manufacturer whose kit you rely on to check for driver updates yourself. But this is a time-consuming and labour-intensive task – and it requires you to know in detail who made not only your printer and webcam, but various chips on your motherboard, your Bluetooth module, Wi-Fi subsystem and more.

Letting Avast Driver Updater do the hard work for you is a far better option. Working in a very similar fashion to Windows Update, Driver Updater analyses your computer and notes all of the hardware components you have attached. The utility can then cross-reference what it's discovered against a database of millions of drivers, and on that basis let you know if you need to install new versions for any particular device.

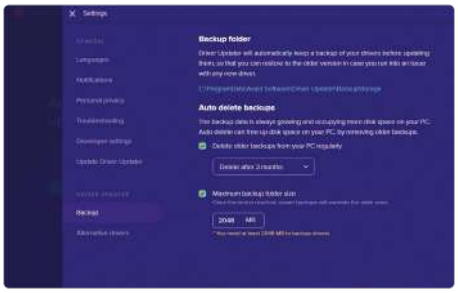
It's a simple idea, but a brilliant one, and it can make a real difference to your computer's stability, performance and security. When all your hardware devices are using the latest drivers, you'll be less vulnerable to driver-related security risks, you should experience fewer freezes or crashes, and you may even be able to enjoy new features, sharper graphics and richer audio.



ABOVE Driver Updater scans all devices – including system components and outboard peripherals – with a single click



ABOVE You can apply all available updates simultaneously, or tell Driver Updater to ignore or skip specific updates



ABOVE Driver Updater automatically keeps backups of your existing drivers, so you can instantly restore them if you run into problems

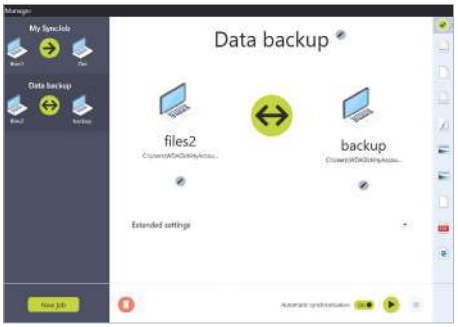
Ashampoo Face Blur

- Protect your identity – and that of your family – by blurring or covering faces in photos
- Process images quickly using automatic facial recognition to find and replace faces
- No photo-editing experience required – choose between blur, pixellation or an emoticon with a single click

Full product worth £15 ashampoo.com
REQUIRES Windows 10 or later; 30MB hard drive space; in-application registration

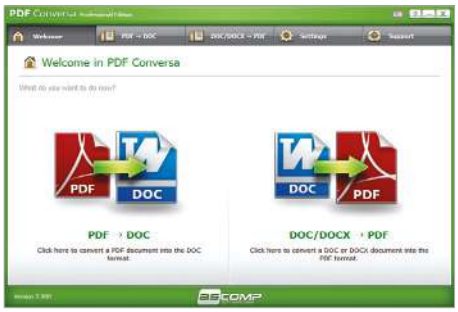
Abelssoft SyncManager 2024

- Back up and synchronise files according to your own custom rules
- Synchronise downloaded MP3s to a media server, copy images from a camera to your Pictures folder, back up documents – and more
- Set up as many sync tasks as you need, each with its own settings and intervals



Full product worth £20 abelssoft.com
REQUIRES Windows 8 or later; 50MB hard drive space; in-application registration

Ascomp PDF Conversa 3.01



Full product worth £17 ascomp.de
REQUIRES Windows 7 or later; 250MB hard drive space; in-application registration

- Easily convert between PDF and Microsoft Word formats – in both directions
- Add digital signatures and passwords to prevent editing, printing or copying
- Save disk space by compressing text and images

IObit Malware Fighter 12 Pro

Six-month licence worth £10 iobit.com
REQUIRES Windows 7 or later; 70MB hard drive space; online registration

- Simple anti-spyware tool to protect your PC against adware, trojans and other threats
- Check the most critical areas of your system, or choose what you want the program to examine
- Protects real-time protection in five key areas

Audials Music Edition 2025 SE

Full product worth £20 audials.com
REQUIRES Windows 8 or later; 250MB hard drive space; in-application registration

- Find tracks online, stream them and download them to your computer
- Search by audio track or music video; play in the app or add it to your collection to listen to later
- Works with many leading streaming services

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pcprodownload.co.uk

* Codes are sometimes limited, so please claim early to avoid disappointment

Apple iPad mini (2024)

Not a major update, but the speedy A17 Pro chip and supremely portable design make this a fine choice

SCORE ★★★★☆

PRICE 128GB/Wi-Fi, £416 (£499 inc VAT) from apple.com/uk

Our Labs this month (*see p76*) weighs up 15 tablets, but if you're wedded to a compact design and Apple's ecosystem then the seventh generation iPad mini might be exactly what you need (it landed too late to be included in the Labs). It's not a revolutionary update over its 2021 predecessor, but a few under-the-hood improvements make it an all-round superior tablet.

The design still resembles a shrunken-down iPad Air, and since it comes with iPadOS 18 preinstalled, you get all the same software features found on the latest iPad Air and Pro models. Those include the upgraded Calculator app and the Smart Script feature, which cleans up your handwriting in real-time to make it more legible. It's also in line to receive the full set of Apple Intelligence features, which the older sixth-generation model will miss out on.

While the iPad mini's capabilities largely match those of the full-sized models, its reduced size gives it a quite different feel. It's so small and light that you can throw it in a bag and easily forget it's there, making it ideal for travel or anyone who finds other tablets clunky.

It feels solid, with a sturdy aluminium chassis that never budges or flexes. Around the edges you'll find the volume buttons, a lone USB-C port and a power button/Touch ID sensor, plus four stereo speakers, which produce a surprisingly big sound. I fired up Dream Theater's "Night Terror" and was impressed by the clarity of the guitar riffs and drum fills, even if the bass wasn't as prominent as I would have liked.

The 8.3in display is the same as the previous model, with plenty of brightness (490cd/m²) and tasteful colour reproduction (100% of the sRGB gamut, 76% of DCI-P3) that looks vibrant but still realistic. It's big enough for viewing films while being small enough to make the mini a great e-reader. I found the bold contrast between the white pages and black inks brought out every detail in the pencil work in a manga such as *Dragon Ball*.

My only reservation about the screen is that the refresh rate remains stuck at 60Hz, rather than the 120Hz of the iPad Air. 60Hz is fine for videos and games, though, and I didn't notice the "jelly scrolling" screen-tearing effect that afflicted the iPad mini 6.

The biggest upgrade is to the chipset, with the old A15 Bionic processor replaced by the A17 Pro, as found in the iPhone 15 Pro. With a six-core CPU, a five-core GPU and a 16-core Neural Engine, the newer processor crushes the older mini 6 for performance. Editing photos and videos on this tablet was a pleasure, and even when I had a dozen Chrome tabs and a YouTube video running, the iPad mini 7 never stuttered.

Gaming performance is respectable. It ran *Resident Evil 4* – one of the most graphically gruelling games around – at a relatively stable 30 frames per second, although it did stutter when I tried playing unplugged. When not gaming, battery life remains on a par with the iPad mini 6. Our web-browsing test clocked up 10hrs 34mins of continuous surfing over Wi-Fi before the battery gave out; that's about 20 minutes less than the previous model, but still plenty of power to get you through the day.

While the iPad mini 7 generally improves on its predecessor, it does have a couple of shortcomings. While most modern iPads now have the front camera in a landscape orientation, the iPad mini 7 sticks with the old design. When you're holding the tablet in landscape mode, the front camera sits on the left-hand side, making it hard to centre yourself during video calls or when taking selfies.

It's also a pity that the Apple Pencil 2 is no longer supported. If you want to sketch, take handwritten notes or play with Smart Script you'll either need to invest in the latest Pencil Pro or the cut-down Pencil USB-C.

In all, the iPad mini 7 isn't a monumental leap forward; three years on from the launch of the last model, I hoped for a more ambitious update. But the changes it does introduce are all for the better, and the base storage has been doubled too, from 64GB to a much more comfortable 128GB, while the price remains the same. Factor in Apple Intelligence and there's plenty to like about the iPad mini 7. If you need a big screen then the Labs-winning iPad Air 11in is a better choice, but for those who prefer a compact companion, this smart little tablet delivers the same style and versatility in a beautifully portable form. **TONY POLANCO**

ABOVE The 8.3in screen is great for reading ebooks

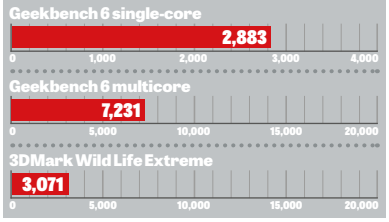
PC PRO RECOMMENDED

LEFT The Pencil Pro is an expensive extra

"It's so small and light that you can throw it in a bag and easily forget it's there, making it ideal for travel"

BELOW There's no screen-tearing in games, despite the 60Hz refresh rate

BENCHMARKS



SPECIFICATIONS

6-core Apple A17 Pro processor • 5-core Apple GPU • 8GB RAM • 8.3in IPS screen, 1,488 x 2,266 resolution • 128GB/256GB/512GB storage • 12MP rear camera • 12MP front camera • Wi-Fi 6E • Bluetooth 5.3 • USB-C 3.2 Gen 2 connector • 19.3Wh battery • iPadOS 18 • 135 x 6.3 x 195mm (WDH) • 293g • 1yr warranty

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Netgear Orbi 770

The cheapest Wi-Fi 7 mesh so far is simple but speedy – if you're ready for next-gen wireless, it's a strong choice

SCORE ★★★★☆

PRICE Twin-pack, £500 (£600 inc VAT); three-pack, £708 (£850 inc VAT) from amazon.co.uk (B0DDPM175C)

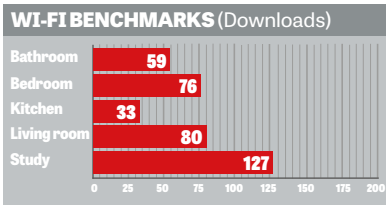
We've reviewed several Wi-Fi 7 routers and meshes with since the technology debuted at the end of 2023, but the Orbi 770 is a different beast to those early-bird devices.

For a start, it's the first that comes with Multi-Link Operation (MLO) enabled. MLO is one of the big new features in Wi-Fi 7, enabling clients to connect to the router using the 5GHz and 6GHz bands simultaneously for improved performance and stability. The firmware on the first tranche of Wi-Fi 7 systems lacked this capability, so this is the first opportunity we've had to try it out.

The other distinctive thing about the Orbi 770 is that it's far cheaper than previous Wi-Fi 7 meshes: a pack of two units (suitable for a floor space of up to 420m²) costs £600 inc VAT, while adding a third station increases the claimed coverage up to 630m² for £250 more. For comparison, Amazon's Eero Max 7 mesh will cost you £1,150 for two units (*see issue 352, p68*), while the top-shelf Netgear Orbi 970 comes in at a whopping £1,500 for two units, or £2,000 for three (*see issue 357, p62*).

Each Orbi unit contains 2.4GHz, 5GHz and 6GHz Wi-Fi radios, with respective top speeds of 688Mbits/sec, 4.3Gbits/sec and 5.8Gbits/sec. All radios use 2x2 MIMO, with support for the newly extended 240MHz and 320MHz channel widths on the upper radio bands. Cleverly, it uses MLO to distribute its backhaul connection across these two bands, helping it make the most of the available bandwidth without eating too much into individual client connections.

WI-FI BENCHMARKS (Downloads)



ABOVE The Orbi 770 is a relatively affordable route into Wi-Fi 7

I was delighted to find that the Orbi 770 supports multi-gigabit Ethernet on every port. The router unit sports a 2.5GbE WAN socket plus three 2.5GbE LAN connectors, while each satellite station offers two 2.5GbE LAN ports. That's a huge amount of bandwidth, both wired and wireless.

Before we get too excited about what speeds might be attainable, however, I must report that MLO isn't the magic performance-doubling bullet you might have hoped for. I established this by testing the Orbi 770 in my own home, in a two-unit configuration befitting the compact and bijou vibe of my North London dwelling. I tested download speeds when copying files from a wired NAS appliance (connected to the primary Orbi router via 2.5GbE) to a test laptop connected to the network via Wi-Fi 7.

The Orbi's performance was a step behind the pricier Wi-Fi 7 meshes, even though the Eero Max 7 and Orbi 970 were tested before the advent of MLO, while the Orbi 770 has the benefit of an aggregated 5GHz + 6GHz link. This doesn't mean MLO is pointless, though: it should still help your connections stay strong and stable in the face of interference and physical obstacles, since the data is spread across a very wide range of frequencies.

And I had no complaints about the coverage area or consistency of the Orbi 770's performance. Its only stumble was in the kitchen, where download speeds dipped to around half of what I was seeing elsewhere, probably indicating that my laptop couldn't sustain a 2x2 MIMO connection in that particular location. Even then, a download speed of 33MB/sec is very hard to quibble with.

In fact, the biggest question about the Orbi 770's performance is whether you really need it. Sure, it's a lot faster than a cheap Wi-Fi 6 mesh such as the simple, functional Mercusys Halo H80X (*see issue 341, p71*), but the Mercusys is still absolutely fine for video streaming, casual gaming and FaceTime calls, and you can get it on Amazon right now for only £115.

Don't expect the snazzy features you get with more expensive routers. Network management and administration can be carried out via either Netgear's standard web interface or the Orbi app, but there are no niceties such as USB media sharing or outbound VPN integration. Netgear's parental controls and the Armor security platform are supported, but only via add-on subscriptions, respectively costing £50 and £85 per year.

"If you're itching to try out the next generation of wireless networking, the Orbi 770 is the best solution we've seen"

LEFT A pack of three Orbi units will cover an enormous 630m²

For most of us, there's no need to rush out and buy this or any other Wi-Fi 7 mesh. Compatible client devices are still thin on the ground, and Wi-Fi 6 is more than fast enough for today's online services.

But if you're itching to try out the next generation of wireless networking – and you need wider coverage than a standalone router can provide – then the Orbi 770 is the best solution we've seen. The price is about as low as you could reasonably ask for, and while performance isn't quite top of the class, it's hard to think of a scenario where the Orbi 770 won't meet and exceed your networking needs, now or many years into the future. **DARIEN GRAHAM-SMITH**

RIGHT The Orbi 770 supports multi-gigabit Ethernet on every port

SPECIFICATIONS

Tri-band 2.4GHz/5GHz/6GHz Wi-Fi 7 mesh • 2.5GbE WAN, 3 x 2.5GbE LAN ports (router), 2 x 2.5GbE LAN ports (satellite) • 1.5GHz quad-core processor • 134 x 100 x 251mm (WDH) • 916g • 2yr warranty

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sales@palicomp.co.uk

pro-series

mid [PRO1]

£449.99

CPU	AMD RYZEN 5 8500G
Core	6 Cores - 12 Threads
Clock	(3.5/5Ghz Turbo)
Mob	ASUS TUF A620M-PLUS WIFI
RAM	ADATA 16GB DDR5 5600Mhz
M.2	TRANSCEND 1TB M.2 nVME
GPU	AMD RADEON Graphics
Case	KOLINK Observatory HF MESH
O/S	*NO OPERATING SYSTEM*
PSU	BUILDER 500W PSU

Max [PRO2]

£979.99

CPU	AMD RYZEN 5 7600X
Core	6 Cores - 12 Threads
Clock	(4.7/5.3Ghz Turbo)
Mob	ASUS PRIME B650M-A WIFI II
RAM	ADATA 32GB DDR5 5600Mhz
M.2	TRANSCEND 1TB M.2 nVME
GPU	NVIDIA RTX4060 TI 16GB
Case	1stPlayer D3-A aRGB - Black
O/S	*NO OPERATING SYSTEM*
PSU	CIT 700W PSU

UBER [PRO3]

£1159.99

CPU	INTEL Core i5 14600K
Core	14 Cores - 20 Threads
Clock	(2.6/5.3Ghz Turbo)
Mob	ASUS B760M-K
RAM	ADATA 32GB DDR5 5600Mhz
M.2	ADATA 2TB S70 Blade M.2 nVME
GPU	NVIDIA RTX4060 TI 16GB
Case	GAMEMAX F15M MESH
O/S	*NO OPERATING SYSTEM*
PSU	BEQUIET 850W Gold PSU

Aurora RANGE

i3 Aurora [AUR1]

£629.99

CPU	INTEL Core i3 14100F
Core	4 Cores - 8 Threads
Clock	(3.5/4.7GHz)
Mob	ASUS B760M-K
RAM	ADATA 16GB DDR5 5600Mhz
M.2	TRANSCEND 1TB M.2 nVME
GPU	NVIDIA RTX3050 8GB
Case	GAMEMAX Abyss Mini RGB
O/S	MICROSOFT Windows 10/11
PSU	CIT 600W Bronze PSU

i5 Aurora [AUR2]

£999.99

CPU	INTEL i5 14400F
Core	10 Cores - 16 Threads
Clock	(Turbo 4.7Ghz)
Mob	ASUS B760M-K
RAM	CORSAIR 32GB DDR5 6000Mhz
M.2	ADATA 2TB M.2 NVMe
GPU	NVIDIA RTX4060 8GB
Case	CORSAIR iCUE 4000X
O/S	MICROSOFT Windows 10/11
PSU	CORSAIR 650W PSU

i7 Aurora [AUR3]

£1599.99

CPU	INTEL Core i7 14700KF
Core	20 Cores - 28 Threads
Clock	(3.4/5.6Ghz Turbo)
Mob	ASUS PRIME Z790-P WIFI - DDR5
RAM	CORSAIR 32GB DDR5 6000Mhz
M.2	ADATA 1TB S70 Blade M.2 nVME
GPU	NVIDIA RTX4070 12GB
Case	CORSAIR iCUE 4000X RGB
O/S	MICROSOFT Windows 10/11
PSU	CORSAIR 650W Gold PSU

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Moto G75 5G Business Edition

A tempting and well-priced choice for business rollouts thanks to easy remote management

SCORE ★★★★☆

PRICE £225 (£270 inc VAT) from Vodafone or BT/EE

PC PRO RECOMMENDED

Sometimes companies make a statement when sending us review samples, and here that meant shipping the G75 in a compact Peli case – a relative of the one Jon Honeyball eulogises on p130. The message is that the G75 is a rugged beast, being the first Moto G series phone to meet MIL-STD-810H tests, including drops from up to 1.2 metres and extreme temperatures. Add an IP68 rating and Gorilla Glass 5, and I'm left wondering what to do with the Peli case.

There's another first here, as the G75 marks the debut of Qualcomm's Snapdragon 6 Gen 3 chip. It's a mid-range offering, as the Geekbench 6 scores below reveal, but you wouldn't know this in day-to-day use. There's certainly no hesitation in Android 14, and I see no reason why the G75 won't keep speeding along for the five years of OS updates that Moto promises.

The appearance of fluidity is helped by a 120Hz screen, and this had no trouble in our technical tests. In Vivid mode, I measured an average Delta E of 0.9, while its 85% coverage of the DCI-P3 space means films look great. It's a big screen, too, stretching 6.8in across the diagonal, which does make a difference if you want to watch shows on the go. While more expensive phones will have a higher resolution than 1,080 x 2,388, which translates to 387dpi, text always looked sharp to my naked eye.

Inevitably, the big screen translates into a chunky device. At 208g and 77mm wide, some people may not be happy at being forced to use it as their company phone. It doesn't help that it's 8.3mm thick. Moto has gone to great lengths to make the G75 look stylish, though, with a vegan leather rear and brushed metal edges. Whether you choose grey, green or blue, you won't be ashamed when whipping this phone out in public.

Don't be dismayed by its relatively limited camera setup. Dual 50MP and 8MP cameras sound positively impoverished next to the quad-lens systems of flagship phones, but I was pleasantly surprised by the quality of the pictures from the main unit. Photos taken in good light are well balanced and pack plenty of detail, and it's accomplished in low-light conditions. Skin tones come out particularly well. And one of the bonuses of using Qualcomm's latest chip is that it includes an NPU, so you can use Magic Eraser on the phone.

I'm less taken by the 8MP camera, which is used for wide-angle and macro shots, likewise the 16MP selfie camera, but these are less important for most users.

Particularly, it could be argued, the professional audience at which the Business Edition of this phone is targeted. It's only available from Vodafone and BT/EE, while the Moto G75 5G is on general sale for £250.

The extra money buys a year of ThinkShield management solutions, which includes Moto Device Manager so that IT admins can control the device remotely. Larger businesses can also benefit from "zero touch enrolment", where your policies and settings are preset for users. There's also Moto Safe, which IT admins can use to lock or disable devices if they're reported lost or stolen.

You get a three-year warranty rather than the year of consumer Moto phones, but all the ThinkShield solutions I mentioned above are only covered for the first year. After that, you'll be hit with a licensing cost, with the amount depending upon the size of your installed base.

One final factor that will appeal to businesses, and users, is the clean interface. Moto adds customisations, but they're genuinely useful – things such as using a chopping motion (twice) to turn on the torch or the screen staying on if you're looking at it (so long as you switch on Attentive Display in the settings). And if you own Lenovo ThinkPads – Motorola is a branch of Lenovo – then you can sign in to your account to make sharing files and streaming apps easier.

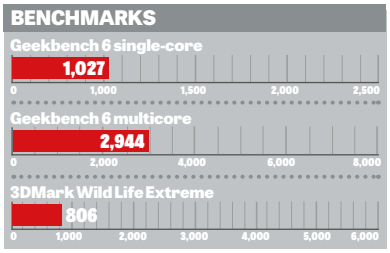
With a 5,000mAh battery that easily lasted a working day, and a respectable 256GB of storage, the only thing that stands in the way of the G75 5G Business Edition earning five stars is its size. But it's fast, the main camera is good and the management tools tick all the right boxes – so perhaps that Peli box is to hold its well-earned *PC Pro* Recommended award. **TIM DANTON**

ABOVE The design is rugged as well as stylish, and the screen is superb

"The only thing that stands in the way of the G75 5G Business Edition earning five stars is its size"

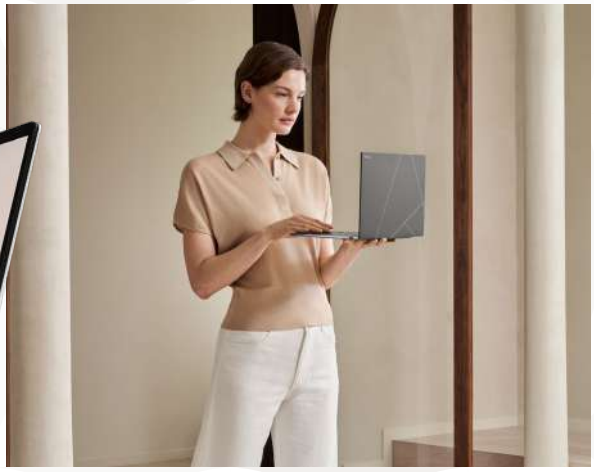
BELOW The G75 has been designed for business rollouts

BENCHMARKS



SPECIFICATIONS

8-core Qualcomm Snapdragon 6 Gen 3 SoC • 8GB RAM • Adreno 710 graphics • 6.8in 120Hz IPS screen, 1,080 x 2,388 resolution • 5G • 256GB storage • IP68 • dual 50MP/8MP rear cameras • 16MP front camera • Wi-Fi 6E • Bluetooth 5.4 • NFC • 5,000mAh battery • USB-C 2 • Android 14 (5yr updates) • 77 x 8.3 x 166mm (WDH) • 208g • 3yr RTB warranty



ASUS Zenbook S 14

From £1,499.99 at uk.store.asus.com

Designed for those who value elegance and performance, this ultra-thin, 14" laptop combines a sleek, sophisticated build with robust power, making it perfect for professionals, creatives, or anyone on the go. The Zenbook S 14 boasts a high-resolution OLED display, delivering vibrant colours that bring visuals to life—a treat for designers and entertainment lovers alike. With Intel's latest processors and impressive battery life, it's a reliable companion through busy workdays or travel.

GEEKOM GT1 Mega AI Mini PC

Christmas deals price: $930. 6% off code: PCPROGEEK at geekompc.com

The GEEKOM GT1 Mega redefines the mini PC with cutting-edge AI capabilities and unparalleled connectivity options. Equipped with dual 2.5Gbps NIC ports, this compact AI mini PC provides exceptional reliability and speed, ideal for high-demand applications such as soft routing, virtual machines, and multi-network setups. Its advanced Intel Core Ultra processor, paired with Arc Graphics, drives robust AI-powered performance, effortless multitasking, and immersive gaming experiences. With the latest WiFi 7 technology, the GT1 Mega delivers lightning-fast wireless speeds and superior stability, making it perfect for seamless cloud gaming and 8K streaming.

This sleek, aluminum-clad Mac Killer boasts a full suite of connectivity options, including six USB-A and two USB4 Type-C ports, to easily support all your peripherals. Enhanced by IceBlast 2.0 cooling and effortless upgradeability, the GT1 Mega is a statement of style and functionality for both professional and personal use.

iiyama G-Master Red Eagle curved gaming monitor

£383 at cclonline.com

Immerse yourself in the game with the curved GCB3481WQSU-B1 Red Eagle with FreeSync Premium. The 1500R curved VA panel with 180Hz refresh rate, 0.3ms MPRT and super sharp 3440x1440 resolution, guarantees superb image quality and a comfortable and very realistic viewing experience which bring your games to life in vivid detail. Customisable user modes give you complete control over your gaming experience, flipping between your favourite set-ups for FPS, 4X and RPG. Powered with FreeSync™ Premium Technology, this monitor guarantees low input latency and low framerate compensation putting an end to any tearing or stuttering issues at virtually any framerate, for the best in-game experience for fast paced gaming.

devolo Magic 2 WiFi 6 combines cutting-edge Wi-Fi with the latest Powerline technology

Streaming, gaming and video calls are part of our digital lifestyle. For these purposes, we are using more and more Wi-Fi devices in all rooms – from the hobby room in the basement to the top-storey workspace. This means stable and lightning-fast Wi-Fi is more important than ever.

The best of both worlds

Introducing the Magic 2 WiFi 6, the world's first Powerline adapter featuring Wi-Fi 6 technology, from the German home network expert devolo. Featuring a maximum Powerline speed of up to 2,400 Mbps and a Wi-Fi performance of up to 1,800 Mbps, the Magic 2 WiFi 6 will take your home network to the next level.

Top-notch Wi-Fi

The flagship product of devolo supports older Wi-Fi standards in addition to the latest Wi-Fi 6. As a result, your home network reaches top speeds while getting "smarter" to boot. One important feature here is OFDMA. This state-of-the-art modulation technology uses Wi-Fi frequencies much more efficiently. This means that more bandwidth is available for each data stream and the number of end devices supplied with high-speed Wi-Fi is maximised.

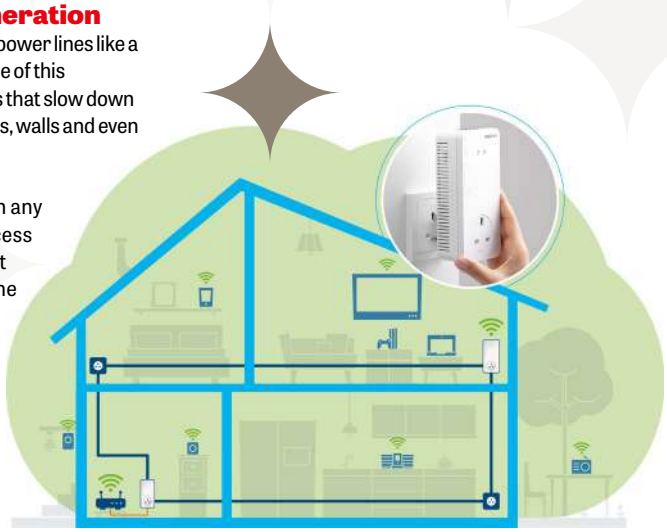
Mesh Wi-Fi for gapless reception

A Mesh system is a wireless LAN consisting of multiple hotspots which create tightly meshed Wi-Fi. Important components of Mesh Wi-Fi are Access Point Steering and Client Steering. These features ensure that mobile devices such as smartphones and tablets are always connected to the strongest Wi-Fi hotspot.

The next Powerline generation

Powerline uses your home's built-in power lines like a long data cable. The major advantage of this technology: It gets around obstacles that slow down Wi-Fi. Such obstacles include ceilings, walls and even floor heating systems.

devolo Magic 2 WiFi 6 lets you turn any power socket into an Internet access point. devolo Magic uses the latest Powerline generation G.hn with the highest performance values. This makes the devolo solution future-proofed.



Installation: Plug & Play!

devolo Magic adapters are ready to use in no time flat. The Home Network app guides the user step by step through the installation. Other settings are also adjusted with the free app – for example, guest network or parental control settings.

devolo Magic 2 WiFi 6

To get started, the Starter Kit is available at a price of £219.99 with two adapters. The devolo Magic 2 WiFi 6 Whole Home WiFi Kit includes three adapters to cover larger living areas and costs £379.99. Add-On adapters are available at a price of £169.99.

For more information, visit devolo.co.uk

Kingston FURY Beast DDR5 RGB

From £109 at kingston.com/gaming

Make it a white Christmas with Kingston FURY Beast DDR5 RGB memory. Experience the superior speed of DDR5, with twice as many memory banks and double the burst length – and overclock in style with cutting-edge technology.
As well as amazing performance, these RAM modules stand out with a stylish new heat spreader design and vibrant RGB lighting, customisable with the FURY CTRL app and guaranteed to stay in sync thanks to Kingston's patented Infrared Sync Technology.

Intel XMP 3.0 and AMD EXPO options include customisable profiles for speeds and timings, 100% tested at speed and backed by a limited lifetime warranty. Kingston FURY DDR5 RGB RAM is the ultimate gift for dedicated gamers and enthusiasts.

Kingston XS1000 External SSD

From £61 at kingston.com/ssdexternal

Compact, eye-catching and very fast, the XS1000 external SSD fits seamlessly into your lifestyle. Despite its small size, this advanced storage solution delivers transfer speeds of up to 1,050MB/s and comes in capacities up to 2TB, making it ideal for securely storing your memories of 2024 and plenty more to come.

With both Type-A and Type-C connectivity, the XS1000 will work with any USB-compatible host, allowing you to effortlessly back up important documents, treasured photos and media files, and keep them readily accessible wherever you may be. It's the perfect gift for yourself or a loved one this season. Available in Festive Red and Black.

ROLI Piano M portable keyboard

£219 at roli.com

The piano that teaches you to play.

If you're seeking gifts for a budding Beethoven – or want to develop your own musical talents – ROLI has just the thing. Piano M is a compact portable keyboard with light-up keys that teaches you to play along with your favourite songs. It works with a companion app for Android and iOS, giving you access to a vast collection of tracks from Beyoncé to The Beatles, and from Sabrina Carpenter to Schubert – plus a stocking's worth of festive hits.

If you've played Guitar Hero or Rock Band before, you'll be right at home. Coloured notes cascade off the screen and onto Piano M's illuminated keys, in time with the backing track. Multiple game modes let you get playing right away, then work your way up to reading traditional sheet music.

Piano M is backed by a thorough curriculum that ensures you pick up the fundamentals of music theory and playing technique along the way. At under £7 per month for an annual subscription, it's far cheaper than traditional piano lessons – and more fun. There's a reason we call it "playing," after all.

TABLETS FOR PROS & CREATIVES

We put the world's best tablets to the test to find the top choice for demanding users

There's an argument that tablets have become the ultimate personal computer: the device that runs the gamut from cheap and cheerful slates designed for apps and media consumption to powerful, big-screen devices capable of media creation and daily business use.

The old divisions between tablets and laptops are certainly falling away fast. Bigger screens and add-on keyboards are bridging the gap in usability, while the divide between laptop and mobile processors continues to blur. In some cases, you'll find the exact same chip in both.

While laptops are getting slimmer and lighter, tablets still have the edge on portability. Even the larger devices come in at somewhere between 500g and 700g, so will effortlessly slide into a bag or backpack. Even with a keyboard, you could be looking at a weight of under 1kg. Smaller options – including the new iPad mini, which landed too late for this test (*see p68*) – give you the perfect halfway house between a laptop and a big-screen smartphone, with more space for reading, web browsing or watching your favourite TV shows and films.

This month we've asked manufacturers to send in their latest and greatest tablets. We asked to see anything between 8in and 15in in size, so that we could look at the full range of devices from family-friendly options to high-end, power-user slates. And as you'll see, our focus is on the latter, so if you're a demanding user or looking for a creative tool then we're confident you'll find your perfect partner here.

You might not be surprised at some of the winners – hint, two begin with "i" – but you might be surprised to find that you don't necessarily need to spend serious money to buy a seriously good device.

CONTRIBUTOR: Stuart Andrews

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Same
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Rice or Noodle Bowl
ith Pork, Shrimp
Chicken or Veggi
Grand Opening
TANIA'S THAI DINER
and Bean Sprouts,
Thai Basil, Chili,
Peanuts, Ginger,
and a Fried Egg.
Lunch Hours:
11 AM - 2 PM

					LABS WINNER	RECOMMENDED	
	Amazon Fire HD 8 (2024)	**Amazon Fire HD 10 (2023)**	**Amazon Fire Max 11**	**Apple iPad**	**Apple iPad Air 11in**	**Apple iPad Pro 11in**	**Google Pixel Tablet**
Overall rating	★★★☆☆	★★★☆☆	★★★☆☆	★★★★☆	★★★★★	★★★★★	★★★★☆
Base storage option	32GB	32GB	64GB	64GB	128GB	256GB	128GB
Price [1]	£83 (£100 inc VAT)	£125 (£150 inc VAT)	£208 (£250 inc VAT)	£274 (£329 inc VAT)	£499 (£599 inc VAT)	£833 (£999 inc VAT)	£333 (£399 inc VAT)
Storage options (price inc VAT)	64GB (£125)	64GB (£180)	128GB (£290)	256GB (£479)	256GB (£699), 512GB (£899), 1TB (£1099)	512GB (£1,199), 1TB (£1,599), 2TB (£1,999)	256GB (£519)
Cellular option (price inc VAT)	N/A	N/A	N/A	64GB (£479), 256GB (£629)	128GB (£749), 256GB (£849), 512GB (£1,049), 1TB (£1,249)	256GB (£1,199), 512GB (£1,399), 1TB (£1,799), 2TB (£2,199)	N/A
Generation	12	13	1	10	6	7	1
Supplier	amazon.co.uk	amazon.co.uk	amazon.co.uk	apple.com/uk	apple.com/uk	apple.com/uk	store.google.com
Dimensions	202 x 137 x 9.6mm	246 x 165 x 8.6mm	259 x 164 x 7.5mm	249 x 180 x 7mm	248 x 179 x 6.1mm	250 x 178 x 5.3mm	258 x 169 x 8.1mm
Weight	337g	434g	490g	477g	462g	444g	493g
Customer service							
Warranty	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB
Overall satisfaction [2]	77%	77%	77%	88%	88%	88%	N/A
Reliability satisfaction [2]	82%	82%	82%	94%	94%	94%	N/A
Core components							
Chipset	MediaTek MT8169A	MediaTek MT8186A	MediaTek MT8188J	Apple A14 Bionic	Apple M2	Apple M4	Google Tensor G2
Number of cores	6	8	8	6	8	9 (256GB/512GB), 10 (1TB/2TB)	8
Clock speed	6 x 2GHz	2 x 2.05GHz, 6 x 2GHz	2 x 2.2GHz, 6 x 2GHz	2 x 3GHz, 4 x 1.8GHz	4 x 3.5GHz, 4 x 2.4GHz	3/4 x 4.4GHz, 6 x 2.85GHz	2 x 2.85GHz, 2 x 2.35GHz, 4 x 1.8GHz
Installed RAM	3GB	3GB	4GB	4GB	8GB	8GB (256GB/512GB), 16GB (1TB/2TB)	8GB
Graphics chip	Mali-G52 2EE MC2	Mali-G52 2EE MC2	Mali-G57 MP2	4-core A14	9-core M2	10-core M4	Mali-G710
Connectivity and expansion							
Wi-Fi	Wi-Fi 5	Wi-Fi 5	Wi-Fi 6	Wi-Fi 6	Wi-Fi 6E	Wi-Fi 6E	Wi-Fi 6
Bluetooth	5.2	5.3	5.3	5.2	5.3	5.3	5.2
GPS	✗	✗	✗	5G model only	✓	✓	✗
NFC	✗	✗	✗	✗	✗	✗	✗
Audio jack	✓	✓	✗	✗	✗	✗	✗
MicroSD	✓	✓	✓	✗	✗	✗	✗
Charging port	USB-C 2	USB-C 2	USB-C 2	USB-C 2	USB-C 3.2 Gen 2	Thunderbolt 3/USB-C 4	USB-C 3.2 Gen 1
USB speed	480Mbits/sec	480Mbits/sec	480Mbits/sec	480Mbits/sec	10Gbits/sec	40Gbits/sec	5Gbits/sec
Display							
Screen size	8in	10.1in	11in	10.9in	11in	11in	11in
Technology	IPS	IPS	IPS	IPS	IPS	OLED	IPS
Resolution	1,280 x 800	1,920 x 1,200	2,000 x 1,200	2,360 x 1,640	2,360 x 1,640	2,420 x 1,668	2,560 x 1,600
Aspect ratio	16:9	16:9	16:9	10:7	10:7	10:7	16:10
Pixel density	189ppi	224ppi	213ppi	264ppi	264ppi	264ppi	276ppi
Other features							
Rear camera	5MP	5MP	8MP	12MP	12MP	12MP	8MP
Front camera	2MP	5MP	8MP	12MP	12MP	12MP	8MP
Fingerprint reader	✗	✗	✓	✓	✓	✗	✓
Face unlock	✗	✗	✗	✗	✗	✓	✗
Battery capacity	Not stated	Not stated	27.8Wh	28.6Wh	28.9Wh	31.3Wh	27Wh
Max charging	15W	15W	15W	20W	20W	30W	15W
Charger supplied	9W	9W	9W	20W	✗	✗	✗
Wireless charging	✗	✗	✗	✗	✗	✗	Optional Speaker Dock
Software							
Operating system	Fire OS 8.3	Fire OS 8.3	Fire OS 8.3	iPadOS 18	iPadOS 18	iPadOS 18	Android 15
App store	Amazon Appstore	Amazon Appstore	Amazon Appstore	Apple App Store	Apple App Store	Apple App Store	GooglePlay Store
Official accessories							
Folio (price inc VAT)	Tablet Cover (£35)	Tablet Cover (£43)	Magnetic Slim Cover (£50)	Smart Folio (£79)	Smart Keyboard Folio (£179)	Smart Keyboard Folio (£179)	Pixel Tablet Case (£90)
Keyboard (price inc VAT)	✗	Bluetooth Keyboard Case (£53)	Fire Max 11 Keyboard Case (£90)	Magic Keybard Folio (£249)	Magic Keyboard (£299)	Magic Keyboard (£299)	✗
Stylus (price inc VAT)	✗	Made for Amazon Stylus Pen (£35)	Made for Amazon Stylus Pen (£35)	Apple Pencil USB-C (£79)	Apple Pencil USB-C (£79), Apple Pencil Pro (£129)	Apple Pencil USB-C (£79), Apple Pencil Pro (£129)	✗

[1] Prices correct at time of going to press but are subject to change. [2] Based on reader feedback in *PC Pro* Excellence Awards 2024. See issue 363, p28 for full details. N/A means not enough feedback from readers for reliable results.

	RECOMMENDED				RECOMMENDED	RECOMMENDED	RECOMMENDED	
	Honor MagicPad 2	**Huawei MatePad 12x**	**Huawei MatePad Pro 12.2**	**Lenovo Tab P12 with Matte Display**	**OnePlus Pad 2**	**Samsung Galaxy Tab S10 Ultra**	**Samsung Galaxy Tab S10+**	**TCL Nxtpaper 14**
	★★★★★	★★★☆☆	★★★★☆	★★★☆☆	★★★★★	★★★★★	★★★★★	★★★☆☆
	256GB	256GB	256GB	128GB	256GB	256GB	256GB	256GB
	£417 (£500 inc VAT)	£458 (£550 inc VAT)	£583 (£700 inc VAT)	£292 (£350 inc VAT)	£374 (£449 inc VAT)	£999 (£1,199 inc VAT)	£833 (£999 inc VAT)	£324 (£389 inc VAT)
	N/A	N/A	512GB (£800)	N/A	N/A	512GB (£1,299), 1TB (£1,549)	512GB (£1,099)	N/A
	N/A	N/A	N/A	N/A	N/A	256GB (£1,349), 512GB (£1,449), 1TB (£1,699)	256GB (£1,149), 512GB (£1,249)	N/A
	2	1	1	1	2	10	10	1
	honor.com/uk	consumer.huawei.com/uk	consumer.huawei.com/uk	lenovo.com	oneplus.com/uk	samsung.com/uk	samsung.com/uk	amazon.co.uk
	275 x 181 x 5.8mm	270 x 183 x 5.9mm	271 x 183 x 5.5mm	293 x 191 x 6.9mm	269 x 195 x 6.5mm	326 x 209 x 5.4mm	285 x 185 x 5.6mm	322 x 222 x 6.9mm
	555g	555g	512g	610g	584g	718g	571g	760g
	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB	1yr RTB
	N/A	N/A	N/A	80%	N/A	85%	85%	N/A
	N/A	N/A	N/A	83%	N/A	90%	90%	N/A
	Qualcomm Snapdragon 8s Gen 3	Huawei Kirin T90A	Huawei Kirin 9000S	MediaTek Dimensity 7050	Qualcomm Snapdragon 8 Gen 3	MediaTek Dimensity 9300+	MediaTek Dimensity 9300+	MediaTek Helio G99 (MT8781)
	8	8	8	8	8	8	8	8
	1 x 3GHz, 4 x 2.8GHz, 3 x 2GHz	1 x 2.5GHz, 3 x 2.15GHz, 4 x 1.5GHz	1 x 2.6GHz, 3 x 2.15GHz, 4 x 1.5GHz	2 x 2.6GHz, 6 x 2GHz	1 x 3.3GHz, 3 x 3.15GHz, 2 x 3GHz, 2 x 2.27GHz	1 x 3.4GHz, 3 x 2.85GHz, 4 x 2GHz	1 x 3.4GHz, 3 x 2.85GHz, 4 x 2GHz	2 x 2.6GHz, 6 x 2GHz
	12GB	8GB	12GB	8GB	12GB	12GB	12GB	8GB
	Adreno 735	Maleoon 910	Maleoon 910 MP4	Mali-G68 MC4	Adreno 750	Mali-G720-Immortalis MC12	Mali-G720-Immortalis MC12	IMG PowerVR GE8320
	Wi-Fi 6	Wi-Fi 5	Wi-Fi 5	Wi-Fi 6	Wi-Fi 7	Wi-Fi 7	Wi-Fi 7	Wi-Fi 5
	5.3	5.2	5.2	5.1	5.4	5.3	5.3	5
	✗	✗	✓	✗	✗	✓	✓	✗
	✗	✗	✗	✗	✗	✗	✗	✗
	✗	✗	✗	✗	✗	✗	✗	✗
	✗	✗	✗	✓	✗	✓	✓	✗
	USB-C 2	USB-C 3.2 Gen 1	USB-C 3.2 Gen 1	USB-C 2	USB-C 3.2 Gen 1	USB-C 3.2 Gen 1	USB-C 3.2 Gen 1	USB-C 2
	480Mbits/sec	5Gbits/sec	5Gbits/sec	480Mbits/sec	5Gbits/sec	5Gbits/sec	5Gbits/sec	480Mbits/sec
	12.3in	12in	12.2in	12.7in	12.1in	14.6in	12.4in	14.3in
	IPS	IPS matte	OLED matte	LTPS matte	IPS	OLED	OLED	IPS matte
	3,000 x 1,920	2,800 x 1,840	2,800 x 1,840	2,944 x 1,840	3,000 x 2,120	2,960 x 1,848	2,800 x 1,752	2,400 x 1,600
	15.6:10	3:2	3:2	16:9	7:5	3:2	16:10	3:2
	289ppi	280ppi	274ppi	273ppi	303ppi	239ppi	266ppi	202ppi
	13MP	13MP	13MP	8MP	13MP	13MP + 8MP	13MP + 8MP	13MP + 5MP
	9MP	8MP	8MP	13MP	8MP	12MP + 12MP	12MP + 12MP	8MP
	✗	✗	✗	✓	✗	✓	✓	✗
	✓	✓	✓	✗	✓	✓	✓	✓
	10,050mAh	10,100mAh	10,100mAh	10,200mAh	37Wh	11,200mAh	10,090mAh	10,000mAh
	66W	66W	100W	30W	67W	45W	45W	33W
	✗	66W	100W	20W	✗	✗	✗	33W
	✗	✗	✗	✗	✗	✗	✗	✗
	Android 14 with MagicOS 8	HarmonyOS 4	HarmonyOS 4	Android 13	Android 14	Android 14 with One UI 6	Android 14 with One UI 6	Android 14
	Google Play Store/Honor App Market	Huawei AppGallery	Huawei AppGallery	Google Play Store	Google Play Store	Google Play Store/ Samsung Store	Google Play Store/ Samsung Store	Google Play Store
	✗	✗	✗	Folio Case (25)	Folio Case 2 (£30)	Smart Book Cover (£94)	Smart Book Cover (£89)	✗
	Smart Bluetooth Keyboard (£76)	Smart Magnetic Keyboard (included)	Smart Magnetic Keyboard (included)	Keyboard Pack (£130)	Qwerty Smart Keyboard (£104)	AI Book Cover Keyboard (£199)	AI Book Cover Keyboard (£159)	✗
	Honor Magic-Pen (£80)	Huawei Pen (£63)	Huawei Pen (£63)	Lenovo Tab Pen Plus (£50)	✗	S-Pen (included)	S-Pen (included)	TCL T-Pen (£30)

Buyer's guide: seven steps to a great slate

Looking for your perfect tablet? Here's what to think about before you buy

1 BUY THE RIGHT SIZE

Tablets now run the gamut from compact 7in devices to monster XXL slates with 14.6in screens. Which to buy now depends less on your budget than what you need your tablet for. Big-screen tablets can be brilliant for productivity and creative applications – the kind of use cases that would usually have you reaching for a laptop – but they're also larger and heavier, and sometimes feel too big for comfortable use in the hand.

Smaller 7in to 10in tablets can have the opposite problem. They're great for portability and media consumption, but too small to get more serious work done. You're also often looking at lower screen resolutions and brightness levels, not to mention a reduction in processing power. On balance, the sweet spot is still filled by the 10in to 12.4in devices, which give you enough screen real estate for a wide range of applications, but in a format that's easier to carry and a better fit for use on the go.

ABOVE Screen sizes range from 7 to 14.6in, with 10 to 12.4in the sweet spot

2 SPLASH OUT ON THE SCREEN

After size, screen quality is the most important factor you need to weigh up. After all, it takes up most of the device. The brighter the screen and the higher the resolution, the clearer and more vibrant the image is going to be.

However, colour capabilities also count. It's not unknown to have tablet screens with a 2K or 3K resolution (between 2,360 x 1,600 and 3,000 x 2,120) and a brightness level of over 400cd/m², but where the screen is only capable of showing 80% of the sRGB colour gamut. And that almost always means it covers under 70% of the DCI-P3 digital cinema standard.

If you're a film lover or you're buying a tablet for creative use, then look for as close to 100% of the DCI-P3 gamut as you can

While we print our results on p94 to help you see exactly how these tablets perform, if you're thinking about buying a different tablet then it's worth checking the small print. Most tablet manufacturers now tell you the expected colour coverage, quoting a mix of sRGB and DCI-P3 percentages. For general use, anything approaching 100% of the sRGB gamut is a good sign.

More expensive tablets will include screens that cover a higher percentage of each gamut and give you not just bolder colours, but more accurate colours – great for entertainment, crucial for creative work. If you're a film lover or you're buying a tablet for creative use, then look for as close to 100% of the DCI-P3 gamut as you can (anything over 80% is respectable). What's more, a growing number of tablet screens support HDR video formats, including HDR10 and Dolby Vision. If you're looking for your own handheld home cinema, consider this a must-have.

BELOW Top-end processors provide many tablets with incredible power

3 FIND THE SPEED YOU NEED

There's more variation in tablet processors than in any other category of computing, with the options starting at low-powered smartphone CPUs to desktop-class Apple M4 chips. The balancing act here is all about cost. Cheaper devices will cover media streaming apps, basic browsing and email with ease, but you won't get such a smooth experience or the capacity for more demanding games and apps.

The fastest MediaTek Dimensity, Qualcomm Snapdragon 8 and Apple M2 to M4 processors will handle just about anything you can throw at them. You'll need to pay £400 or more to reach this pinnacle, but bear in mind that you don't always need the most expensive model to get a speedy CPU. The iPad Air costs significantly less than the iPad Pro, but still comes with a desktop-class M2.

Don't forget about RAM, either. Tablet operating systems are significantly less demanding of RAM than desktop operating systems, but apps, games and even websites can use a surprising amount these days. As a rule of thumb, paying extra for a tablet with 6GB, 8GB or more is a wise investment.

4 BE REALISTIC ON STORAGE

One way manufacturers differentiate cheaper variants of a device from more expensive options is by offering more storage – and usually making you pay over the odds. Sadly, as storage isn't usually upgradable and plug-in SSDs aren't always an option, they often have you over a barrel.

Be realistic. If you don't install many apps or download music or video for offline consumption, then the cheaper 32GB, 64GB or 128GB version could be fine. If you're using your tablet for business or content creation, however, then cheapskating on storage now could cause you grief in the long term. There is an exception with tablets where you can expand the onboard storage with inexpensive microSD cards, but bear in mind that these are often too slow for running more demanding applications and are best suited to media storage.

5 CONNECTIVITY MATTERS

Physical connectivity is always minimal, and you can often expect just one USB-C port for charging and data transfer. Even here, you may find bandwidth stuck at USB 2 or USB 3.2 Gen 1 levels rather than USB 3.2 Gen 2, Thunderbolt 4 or anything faster. In terms of speeds, that means 480Mbits/sec, 5Gbits/sec, 10Gbits/sec and 40Gbits/sec, so quite the range.

Arguably, wireless connectivity is more important. You won't find a tablet without Bluetooth support, and all now support Bluetooth 5.2 or above. When it comes to Wi-Fi, Wi-Fi 6 is now pretty much ubiquitous, with many devices supporting Wi-Fi 6E or even Wi-Fi 7. It probably won't make much difference when you're sitting in a hotel lobby or a coffee shop, but faster connectivity can be hugely important when connecting to the cloud, the corporate network or streaming services in the office or at home.

ABOVE Amazon's Fire OS is easy to use, but its app choice is inferior to Android and Apple's

BELOW A stylus really boosts the versatility of a tablet

6 SOFTWARE IS EVERYTHING

Even more than a laptop or a PC, tablets work within an ecosystem of software, app stores and cloud services, affecting everything from the basic look and feel to the apps and services you use. Despite the best efforts of Google, Lenovo and Samsung, Apple still has the edge here. Its iPadOS remains the most effective and intuitive tablet operating system, and Apple's app ecosystem is unsurpassed, covering the widest range of consumer and professional apps. Android, and Samsung's and Lenovo's spins on Android, have improved massively in the past few years, with impressive productivity and multitasking features, but the Google Play app store still lags behind.

The other major player here is Amazon with its Fire OS. On the good side, it's a very coherent and easy-to-use environment that puts content consumption and entertainment first. On the bad side, the Silk browser lacks the speed and flexibility of Safari and Chrome, and the app selection is far poorer than Android's.

7 ACCESSORIES ARE KEY

Increasingly, accessories are crucial to making your tablet more versatile. Combine the right tablet with a keyboard case and it becomes an effective, lightweight laptop substitute. Get a stylus, and your tablet becomes a note-taking, document-reviewing powerhouse or a digital design tool. Apple's tablets are blessed with the brilliant Magic Keyboard and Pencil accessories, but Android tablets from Samsung, Lenovo and OnePlus have their own great alternatives, and there are some usable options for Amazon's Fire tablets.

And if you don't fancy paying over £100 for an Apple Pencil, then look around. You can also use a range of third-party styluses, most costing around £20 or less, while numerous third-party folio cases and Bluetooth keyboards exist, too. Some of these are excellent, others less so. If you're tempted to buy one on Amazon, don't simply plump for the option with the highest rating: first, install the FakeSpot plugin and make sure the reviews and ratings are genuine.

Who's the most reliable tablet retailer?

If you subscribe to *PC Pro*, or happened to buy last month's issue, then you will know that Apple won our award as the Best Tablet Manufacturer. This is based on feedback from hundreds of iPad owners who let us know how satisfied they were with everything from customer support to battery life and speed. You can see a summary of the scores here.

Samsung pushed Apple close, with 95% of Galaxy Tab owners telling us they'd buy the brand again. That isn't far behind the 97% of iPad owners. Lenovo has room for improvement here, as does Amazon.

We set a threshold of feedback from at least 50 people for results to be published, which is why you don't see any results for Google, Honor, Huawei, OnePlus and TCL. Don't read in anything into their absence, other than that they haven't yet made a big impression on tablet sales in the UK.

	CUSTOMER SUPPORT	RELIABILITY	VALUE FOR MONEY	SPEED	BATTERY LIFE	CHOICE OF SOFTWARE/ ACCESSORIES	BUY AGAIN?	OVERALL
APPLE	86%	94%	79%	91%	85%	85%	97%	88%
SAMSUNG	80%	90%	81%	85%	82%	80%	95%	85%
LENOVO	73%	83%	83%	76%	81%	74%	88%	80%
AMAZON	76%	82%	86%	71%	78%	61%	82%	77%

Apple iPad Air 11in

The best tablet for most people, with desktop-class performance and an excellent screen

SCORE ★★★★★

PRICE 128GB, £499 (£599 inc VAT)
from apple.com/uk

There are two ways of looking at the iPad Air M2. You could see it as a lighter, premium version of the iPad, with significantly better specs and a slightly better screen. Alternatively, you could look on it as the iPad Pro that the rest of us can afford, dropping a few specs and features here and there to hit a lower price. Either way, there's a compelling argument that this is the best iPad for most of us to buy.

In the hand, it doesn't look or feel an awful lot different from the same-sized iPad Pro. It's roughly 1mm larger on one axis and 1mm smaller on another, 0.8mm thicker and 18g heavier. It uses the same premium materials and has the same premium feel. The single USB-C port now claims to max out at 20W charging speeds – though tests have found it can charge faster – and it uses USB 3.2 Gen 2 for data transfer, rather than the Pro's USB 4. It says a lot that, to tell the difference between the two tablets, we had to check the colour and the text on the back.

There's more a visible distinction with the screen, as the iPad Air still uses IPS technology rather than the iPad Pro's OLED tech. The Air can't go nearly as bright, reaching 563cd/m² with adaptive lighting turned on or 511cd/m² in normal use, and contrast isn't as strong, but this is still an excellent display.

Text and images look sharp thanks to the 2,360 x 1,640 resolution, and it can reproduce 100% of the sRGB colour gamut and 74% of DCI-P3. With an average Delta E of 0.85, colours are still accurate enough for critical design work. HDR movies and TV shows look fantastic, with beautiful, vibrant colour and a natural, cinematic tone. The sound is also deep and rich by tablet standards, to the extent that you can happily watch a film or even listen to some background music without reaching for a set of headphones.

Like the iPad Pro, the iPad Air features front and back 12MP cameras, and stills and video wouldn't disgrace a decent mid-range smartphone. Even in dim lighting you can get fairly clear and well-exposed shots, while footage from the front camera is more than good enough for video chats and online meetings.

Meanwhile, the iPad Air pretty much functions as an iPad Pro when it comes to creative and productivity scenarios. You can pair it with the same excellent Magic Keyboard or Smart Keyboard Folio case and use your iPad as a substitute laptop, or pull out the Pencil USB-C or Pencil Pro for notes, illustrations and careful retouching. You've also got the Dock and the full range of Stage Manager features for handling overlapping windows and split-screen views. With these you can multitask between a selection of apps, and while it's still not as flexible as a standard desktop UI, it's getting very close – and arguably better suited to a smaller tablet screen.

ABOVE The iPad Air is the best combination of performance and price in the Labs

PC PRO LABS WINNER

LEFT A 2,360 x 1,640 resolution makes text and images look sharp

BELOW Pair it with the Magic Keyboard and you've got a laptop replacement

As for performance, the iPad Air comes a way behind the iPad Pro in most of our benchmarks. The latter's M4 processor gives it additional and more efficient cores to work with, not to mention a faster GPU and NPU. Yet the iPad Air's scores still tower over those of any Android rivals, and it's significantly faster in graphically intensive and 3D applications. You can still play *Resident Evil 4* or edit 4K video without any worries. And if the battery life isn't up there with the iPad Pro's superb efforts, 12hrs 49mins isn't to be sniffed at.

Given that the iPad Air starts at £599 rather than £999, albeit with 128GB rather than 256GB of storage, all this makes it an excellent deal. In fact, unless you feel you're going to need the extreme performance of the M4 model – or you really can't live without that OLED screen – the iPad Air makes its more expensive sibling look overpriced. Weighing up the performance, features, quality and value, it's the smartest choice in the Labs.

Apple iPad Pro 11in

It's expensive, but no other tablet has this much capability and all-round class

SCORE ★★★★★

PRICE 256GB, £833 (£999 inc VAT)
from apple.com/uk

The latest iPad Pro seems an impossible proposition. On the one hand, it's ludicrously thin and light (5.3mm and 444g). On the other, it's incredibly powerful, with a desktop-class M4 processor that's in a different league from anything else you'll find in this month's Labs. It's a device that could genuinely work as a laptop replacement, if furnished with the right accessories, or provide a lightweight alternative for professional work while you're out on the road.

Apple has aced the physical design. The aluminium shell and glass front feels seamless, while it's well balanced in the hand and easy to hold. The top button and volume up/down controls are clustered around the top-right corner, with the latter automatically switching direction when you hold the tablet in landscape mode; a trick that surprisingly few Android tablets have followed. There's just one port, but it supports 30W charging, USB 4 and Thunderbolt 3, with data transfers of up to 40Gbits/sec.

The OLED screen is the best of any iPad, reaching SDR brightness levels of 941cd/m² with adaptive brightness on and a torch shone on the sensor. In normal conditions, it reaches over 500cd/m². It covers 100% of the sRGB colour spectrum, though only 77% of DCI-P3, and goes one better than most tablets with a colour-accurate Reference Mode complete with fine-tuned calibration for colour-sensitive design work. With Reference Mode engaged we saw an average Delta E of 0.81, which is easily low enough for professional users. Even if you don't care about colour accuracy to that extent, you'll be delighted by the rich, high-contrast images and superb rendering of HDR effects.

Apple has pulled another neat trick with the audio, with the four speakers producing a much fuller, wider sound than you'd think possible from such a slim device. In some music tracks, not to mention games and films, specific sounds seem to emanate from a point two or three inches to the left or right of the slate. Meanwhile, the rear and front cameras – both 12MP – produce stills and 4K video of the kind of quality you might expect from a decent mid-range smartphone. If you need to take a meeting on the road, you won't have any worries about looking or sounding professional. Well, if you do, it won't be the fault of the iPad Pro.

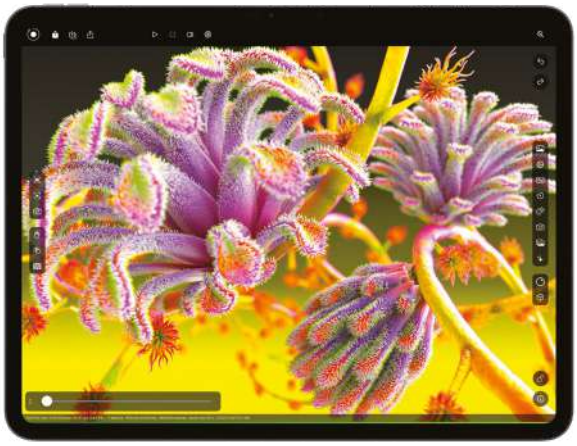
A quick glance at the graphs on p94 will tell you that performance is ridiculously good. The iPad Pro's Geekbench 6 scores are what we'd expect from a high-end laptop, not a tablet, and the iPad Pro really isn't any less capable. In fact, even when you're looking at 4K video in DaVinci Resolve or editing high-resolution, multi-layered image files in Affinity Photo, there's a feeling that you're only scratching the surface of what the iPad Pro can do.

ABOVE The iPad Pro is the best tablet money can buy – if you can afford it

PC PRO RECOMMENDED

LEFT Camera quality is up there with a good mid-range phone

BELOW The OLED screen is ideal for professional use



Meanwhile, the performance in GPU Compute and AI tests whets the appetite for what Apple's tablet might be able to do with Apple Intelligence onboard. When it comes to 3D horsepower, the M4 kicks sand in the face of every other tablet on test. You'll be amazed that console-quality games such as *Resident Evil 4* can run so well on a lightweight, passively cooled device.

iPads haven't usually excelled when it comes to battery life. Apple usually specifies 10 to 12 hours, and that's pretty much what you get. However, the iPad Pro is an exception. In our battery rundown test, it kept going for over 16 hours of video playback, over three hours more than the iPad Air.

The iPad Pro still isn't a perfect laptop replacement. The expensive Magic Keyboard makes it feel very close, with a responsive touchpad, a spacious layout and a great tactile action on the keys. However, iPadOS still works better for switching between tasks than working across multiple apps, despite Apple's split-screen views and talk-switching controls working well. And, needless to say, it's fiendishly expensive. Our 1TB review model with 16GB of RAM costs a whopping £1,599, which would buy you a 16GB/512GB MacBook Air. But if you must have the best and can afford it, look no further.

Honor MagicPad2

Flagship power and a great OLED screen at a bargain price, and it fits snugly into the Honor ecosystem

SCORE ★★★★★

PRICE 256GB, £417 (£500 inc VAT)
from honor.com/uk

Honor has produced some cracking budget tablets in the past few years, with the Honor Pad 9 and Pad X9 delivering decent screens and specs at bargain prices. With the MagicPad2, however, it's targeting the mid-range big leagues. With an OLED screen and a flagship-level processor, it's the kind of slate that leaves you wondering: why pay more?

It's a slim 274.5 x 180.5mm unit, under 6mm thick and weighing 555g. It takes its cues from the iPad Air, though it's thicker and heavier at 555g, and the metal shell – available in black or white – doesn't feel quite as premium. Still, there's nothing wrong with the construction, and the worst that you can say about the physical design is that it's a bit generic, the USB-C port only goes as far as 480Mbits/sec USB 2 speeds, and there's no microSD card slot.

Still, who cares once you look at the screen? It's a 12.3in OLED panel with a 3,000 x 1,920 resolution. It's bright, reaching highs of 581cd/m² with SDR content, and text looks beautifully sharp and clean. You get the flawless contrast of OLED, plus it covers 100% of the sRGB gamut and nearly 91% of DCI-P3. Stick to the Normal rather than the Vivid colour preset and colours are accurate as well, with an average Delta E of only 1.07. It's an incredible display for a tablet at this price.

We're not so knocked out by the picture quality from the 9MP front and 13MP rear cameras; you can get good results with plenty of light to work with, but the image became grainy in gloomier conditions, and the exposure sometimes works too hard to brighten things up. You might also want to avoid the default Beauty setting if you're taking a video call or meeting, as it creates some weird artificial skin textures and other artefacts creep in.

Honor's MagicOS UI sits somewhere between iPadOS and stock Android, with a dock at the bottom of the screen and several pages of apps. Honor also insists on preinstalling its own software, including Notes, Email, Honor Health and an Honor Docs office app, not to mention a Themes app stacked with wallpapers and optional fonts, some of which you'll have to pay for. There's also Honor's own App Market, though there's little reason to use it instead of the standard Google Play Store. On the plus side, it does a solid job of multitasking, complete with floating windows, easy task-switching and intuitive split-screen views. And if you already own an Honor phone or laptop then you can work seamlessly across them (*see p89*).

If you buy the MagicPad2, it's definitely worth spending £76 on the optional keyboard folio. There's no trackpad and it uses Bluetooth for the connection, but the keys are large and the layout spacious given the limited size, with a nice, tactile action. It's ideal for quick emails, drafts and edits.

ABOVE The fantastic OLED screen is a real highlight of the tablet

LEFT The 13MP rear camera takes decent snaps in good light

RIGHT The keyboard folio is a very useful addition

PC PRO RECOMMENDED

Better still, the MagicPad2 has the power to do more than browsing and content consumption. Its Snapdragon 8S Gen 3 chipset features one Arm Cortex-X4 core running at 3GHz, four Cortex-A720 cores at 2.8GHz and a further three Cortex-A520 cores at 2GHz. It's fast enough to put the MagicPad2 in the top third of our benchmark table for the majority of our benchmarks, just ahead of the OnePlus Pad 2 (except for the 3D graphics benchmarks, where the OnePlus Pad's faster GPU wins out).

As for battery life, the MagicPad2's 10,050mAh battery kept it going for nearly 18 hours of video playback, leaving the Samsung and Apple competition far behind. Running the screen at maximum brightness will have an impact on that stamina, but this is a tablet that won't need daily charging unless you're using it day in, day out.

If you haven't got more than £500 to spend on a tablet, put this one on your shortlist. The screen and spec are fantastic for the money, and it's more a question of preference than anything else whether you go for this or the OnePlus Pad 2. The latter is a little cheaper, with less bloatware, faster Wi-Fi and a stronger GPU, but the MagicPad2 has the better display and some performance wins. Either will give you huge amounts of bang for buck.

Huawei MatePad Pro 12.2

Superb hardware, including a gorgeous OLED panel, but Huawei's software won't be for everyone

SCORE ★★★★☆

PRICE 256GB, £583 (£700 inc VAT)
from consumer.huawei.com/uk

The Huawei MatePad Pro 12.2 is a mid-range tablet with high-end aspirations, giving you a premium design and a stunning OLED screen at a lower price than the equivalent Apple or Samsung devices – and with a keyboard folio case bundled in. In many respects, it's a stunning bit of hardware, but with serious issues you need to think about before you buy.

Let's start with the good stuff. Where many Android tablets resemble cheap and cheerful knock-offs of the iPad Air, the MatePad Pro 12.2 feels closer to the iPad Pro. The alloy casing, in a matte gold finish with a shiny frame, feels great in the hand. It's light at 512g and slim at 5.5mm, giving you a bigger 12.2in screen without much added heft. The fit and finish is difficult to fault, though you might complain about the connectivity. The USB-C port supports 5Gbits/sec USB 3.2 Gen 1 speeds, but not the higher speeds of the iPad Air or iPad Pro.

The Tandem OLED screen is another strength, with a 2,800 x 1,840 resolution, a 274ppi pixel density, a maximum brightness of 2,000cd/m² and a 144Hz refresh rate. The image is bright, colours are rich and highly saturated, while the usual OLED advantages – deep blacks and lots of contrast – make watching 4K/HDR video a joy.

In tests, we found the screen could exceed 1,000cd/m² with automatic brightness turned on and a torch pointing at the camera, while it sticks around 600cd/m² when viewing standard SDR material. It covers 100% of the sRGB colour gamut and 99% of DCI-P3, with high gamut volumes to match. In Normal mode, colour accuracy is excellent, with an average Delta E of 0.9. What's more, there's a clever Natural Tone setting that adjusts the colour according to the lighting for a more paper-like presentation. It's ideal for scrolling through long documents or reading comics, books and magazines, although – weirdly – an additional eBook mode isn't nearly as effective.

If the screen quality comes close to iPad Pro levels, the sound might be even better. There's a slight thinness that tells you that you're listening to a tablet, but otherwise the audio is punchy, warm and extremely likable.

Even on the cameras – an area where mid-range Android tablets tend to struggle – the MatePad Pro 12.2 punches well above its class. Stills are sharp and well exposed even when the lighting isn't perfect, and while the 8MP front-facing camera has a tendency to smear on movement, it still copes well with tricky or gloomy conditions.

ABOVE Watching 4K content on the superb OLED screen is a joy

LEFT The cameras are far better than most mid-range tablets

BELOW The bundled keyboard folio connects wirelessly

The bundled keyboard folio is another highlight. It connects seamlessly and wirelessly through Huawei's NearLink tech and while the soft and silent action won't be for everyone, there's plenty of travel and the layout isn't cramped at all. The touchpad is on the tiny side, at 10.5 x 5.7cm, but still workable. It's a great setup for getting things done.

That's helped by Huawei's HarmonyOS software, which does a decent job of handling multiple floating windows and split-screen views. However, it's here that things start going wrong for Huawei. As you're probably aware, it's banned from using Google's services or the Google Play store, which leaves you reliant on Huawei's own app store and resources on the web. Huawei has worked hard on this stuff, and it's a lot easier to find most apps than it was two years ago, yet there's still a Wild West feel to using the MatePad Pro and trying to get hold of apps from safe sources. This isn't necessarily a deal breaker, but you need to know what you're getting into first.

Meanwhile, Huawei's own silicon is struggling to compete with the best from Apple, MediaTek and Qualcomm, resulting in a disappointingly low position in our benchmark tables for the MatePad Pro. Battery life is pretty good, with 16-and-a-half hours of HD video playback, but you still might be left wanting more power. The result is an easy tablet to admire, but a tricky one to recommend.

OnePlus Pad 2

With strong performance and stellar battery life, this is a superb mid-range Android slate

SCORE ★★★★★

PRICE 256GB, £374 (£449 inc VAT)
from oneplus.com/uk

The OnePlus Pad won a Recommended award in last year's tablets Labs and has been a staple of our A List ever since. As with the best of the brand's smartphones, it did so by delivering premium quality at a sensible mid-range price, with an excellent screen, good performance and outstanding battery life. As a result, we had some major expectations for the sequel, which at first appears to be more of a refinement than a revolutionary update. Yet with a few changes to the screen and the internal spec, the Pad 2 is even better than its predecessor.

Physically, it's not hugely different. OnePlus has stuck to the unusual 7:5 aspect ratio of the Pad, giving you a screen that's slightly squarer than the average Android tablet display when viewed in a landscape format. It's 1cm wider and 6mm taller than the old version, though the 6.5mm thickness is pretty much the same. The weight has also risen from 552g to 584g, while the colour has switched from the distinctive green of the original to a less inspiring but still elegant metallic grey.

The fit and finish is every bit as good, with a curved alloy shell and minimal bezel that hold up well against the higher-end Samsung and Apple competition. Meanwhile, OnePlus hasn't skimped on connectivity. Not only do you get Wi-Fi 7 onboard, but Bluetooth 5.4 and a USB-C 3.2 Gen 1 port, capable of data transfers at 5Gbits/sec. This also supports 67W fast charging, though OnePlus doesn't actually provide any charger in the box.

This year's slate is bigger because the screen is bigger, growing from 11.6in to 12.1in. This doesn't sound huge in comparison to the 14in displays you'll find elsewhere, but the squarer aspect ratio makes it seem bigger than it is, especially when you're browsing the web or using business and productivity apps. The 3,000 x 2,120 resolution and 303ppi pixel density make for a fantastically crisp and detailed picture with smoothly rendered text, and the near-600cd/m² brightness levels and strong contrast make it brilliant for streaming TV or films. What's more, the sound is expansive and full-bodied to match.

OnePlus's Oxygen OS remains one of the smarter Android variants, with a taskbar and intuitive task view that makes it easy to run apps in resizable floating windows or split-screen views, though you can only have one floating window at a time. OnePlus still sells an optional smart keyboard with trackpad that can turn the Pad 2 into a handy laptop substitute, though with what's still a tablet-style interface rather than the desktop UI of Samsung's Dex.

ABOVE The OnePlus Pad 2 is even better than its A-Listed predecessor

LEFT Both the front rear cameras are better than most

BELOW The optional smart keyboard turns the Pad into a fine productivity device

Nobody buys a tablet for its cameras, but both the 13MP rear-facing and 8MP front-facing camera are noticeably better than you'll find on other mid-range Android tablets, capturing detailed, well-exposed stills and video even when the lighting isn't perfect. If you want to use a tablet for Google Meet and Zoom calls, the Pad 2 is up to the job.

Yet the key upgrade here is a switch of CPU, from the MediaTek Dimensity 9000 of the original Pad to Qualcomm's flagship Snapdragon 8 Gen 3. Combined with 12GB of RAM, it's fast enough to put the OnePlus Pad close to the top of the benchmark tables, with only the Samsung Galaxy S10 duo, the Honor MagicPad2 and Apple's iPads above it. In fact, the Pad 2 beats the basic iPad and the MagicPad2 in 3DMark and GFXBench, even pulling ahead of the Samsung tablets in the latter. If you're keen on Android gaming it's a real contender, and it will handle just about anything else with ease. From video editing to office apps to *Genshin Impact*, the Pad 2 can do it all.

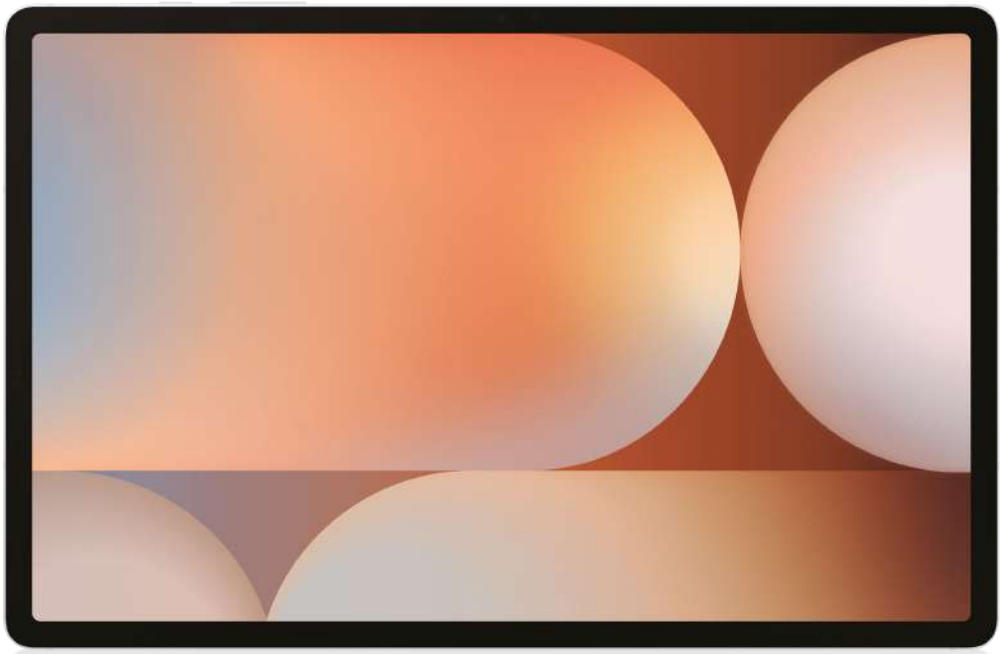
The icing on the cake is its stellar battery life. Last year the OnePlus Pad kept on trucking through over 17 hours of HD video playback. This year, the OnePlus Pad 2 topped that by lasting 18hrs 34mins. That doesn't quite make it the longest-lasting tablet on test, but it's close. Despite some stiff competition from Honor, this is the best Android slate without a Samsung logo on it, and it leaves you wondering if you really need to pay twice as much when what you've got here is so good.

Samsung Galaxy Tab S10+

The best of the premium Android tablets, with superb performance and a stunning screen

SCORE ★★★★★

PRICE 256GB, £833 (£999 inc VAT)
from samsung.com/uk



Samsung's plus-sized Galaxy tablets often play second fiddle to its Ultra flagships, probably because you don't get the same awestruck response from the smaller 12.4in screen. Yet it's a better option for most people. The 12.4in diagonal gives you a large and comfortable display in a smaller 185 x 285mm footprint, while it's still ridiculously thin and light at 5.6mm and 571g. It's easier to hold one-handed, in either portrait or landscape mode, and an easier fit in many bags.

It's also a stunning-looking device, and a redesigned and reinforced frame means it's more robust than ever. In fact, the IP68-rated casing means it's dust-resistant and water-resistant for submersion in up to 1.5m of water for up to 30 minutes.

The screen might be smaller than on the Galaxy Tab S10 Ultra, but you don't lose much in terms of quality. Brightness tops out at a lower 497cd/m² in SDR content with adaptive brightness enabled, but otherwise it's still a spectacularly vivid and sharp display, with the 2,800 x 1,752 resolution giving you a higher 266ppi pixel density. It covers 100% of the sRGB colour palette and 93 of DCI-P3 in the default Vivid mode, with an average Delta E of 0.73. HDR and Dolby Vision content looks nothing short of incredible, and it will easily handle creative work.

The audio is every bit as good, with the four speakers, two on each of the short sides of the tablet, producing a warm, well-rounded output with crystal detail and even hints of bass.

The S10+ isn't short of high-end features, either. True, it misses out on the Tab S10 Ultra's Wi-Fi 7 support, but you still get Wi-Fi 6E and a USB-C 3.2 Gen 1 connection, not to mention a superb set of cameras, front and rear. Crucially, the S10+ has the same MediaTek Dimensity 9300+ CPU as its larger sibling, along with the same AI features. You've got live translation in chat and messaging apps plus AI text suggestions, AI transcription and summary of recordings, AI-enhanced drawing and AI wallpapers, along with object resizing or removal in the Photo Editor app.

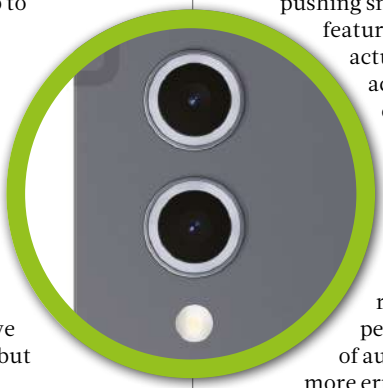
Plenty of tablet manufacturers are pushing small-scale AI features, but Samsung is actually integrating it across its apps. You can also set these features to process your data only on the device, though Samsung warns that this doesn't always work. The results often aren't perfect – transcriptions of audio recordings had more errors than when transcribed by Google's AI on a Pixel 7 phone – but they're usually good enough for everyday use.

What's more, the S10+ benefits from Samsung's One UI software, which remains the best Android implementation of split-screen and multitasking, especially in Dex mode, with its support for multiple floating, resizable windows and a fully functional dock. Pair the S10+ with a Bluetooth keyboard, and it makes an effective desktop productivity device. And while you're out and about, the S-Pen is ideal for handwritten notes and doodles, with the tablet transforming the former into text and the latter into AI-enhanced drawing, should you want it to.

All this takes some serious processing power, but the Dimensity 9300+ has plenty on tap. The S10+ and S10 Ultra delivered similar results across our benchmarks, trading positions from test to test, but consistently were in the top four tablets, just below the iPad Air and iPad Pro. While Apple's super-tablets are on a higher level, the S10+ still feels impressively slick and speedy in practice. You might not be getting desktop-class power, but it isn't too far off.

With a smaller screen, we expected the Tab S10+ to last longer than the S10 Ultra, but with a smaller 10,090mAh battery it fell slightly short, at 12hrs 56mins. That's a close match to the iPad Air, though not the iPad Pro, and enough for most people to get away with a daily charge.

In short, the Galaxy Tab S10+ is as good as Android tablets get. It's cheaper than the S10 Ultra and – for most purposes – more practical, yet you don't really lose anything important. And while there's increasingly stiff competition from mid-range marvels such as the Honor MagicPad2 and OnePlus Pad 2, the Tab S10+ still feels more premium and polished to justify the extra outlay.



LEFT Both the front and rear cameras are superb

ABOVE HDR and Dolby Vision content looks incredible on the sharp and vivid screen

PC PRO RECOMMENDED

BELOW The bundled S-Pen is ideal for handwritten notes and doodles

Samsung Galaxy Tab S10 Ultra

If screen size matters for your applications, this 14.6in monster is the premium tablet to buy

SCORE ★★★★★

PRICE 256GB, £999 (£1,199 inc VAT)
from samsung.com/uk

On the surface, Samsung's super-sized tablet hasn't changed significantly since last year's model. It's still a whopper, with a 209 x 326mm footprint to fit in that enormous 14.6in screen. It's an imperceptible 0.1mm thinner than the Tab S9 Ultra, not to mention 14g lighter, but you'd be hard pressed to spot any other differences bar a reinforced frame. Samsung's OLED display looks amazing, but then it looked amazing when we saw it last year.

There's yet more going on beneath the surface. Samsung has switched processors from Qualcomm's Snapdragon 8 Gen 2 to MediaTek's Dimensity 9300+ and upgraded the Wi-Fi from Wi-Fi 6E to Wi-Fi 7. Most of all – and bang on trend – it's made AI a major selling point, with onboard acceleration through the Dimensity 9300+'s GPU and NPU, for a combined 68 TOPS of AI performance. Samsung hasn't just provided the hardware, but also a range of software features designed to exploit it, including live translation, rapid audio transcription, photo-editing tools and AI-assisted drawing.

The screen is not just one of the biggest you'll find on any tablet, but one of the best. It can go bright, reaching over 600cd/m² in adaptive brightness mode and up to 775cd/m² with HDR content, though it settles to around 380cd/m² in everyday use with SDR material. Contrast is perfect, colours are rich and nicely saturated, and watching HDR or Dolby Vision films is an absolute treat. In tests with the default Vivid setting, it covers 100% of the sRGB gamut and 99% of DCI-P3, with an average Delta E of 0.22. That's easily good enough for professional design and video applications.

If using a regular-sized tablet as a camera can turn you into a nuisance, then using this one should be a crime, but if you need to then the 13MP standard camera and 8MP wide-angle camera on the rear will give you excellent results: bright but not overexposed, with punchy colour and plenty of detail. The front-facing dual 12MP cameras are also fantastic, making this a solid option for video chats and meetings where you have the space.

Crucially, the performance from the new processor is superb. The two Galaxy Tab S10 tablets tower over the Android competition in our benchmarks, particularly in multithreaded and compute tests, where the unusual arrangement of cores – one Arm Cortex X4 at 3.4GHz, three at 2.85GHz and a further four Arm Cortex A720 at 2GHz – works wonders when it comes to piling through complex tasks. The differences were even more pronounced in our 3D benchmarks, with only the OnePlus Pad 2 coming close in Wild Life Extreme. The results in Geekbench AI also look extremely promising for future AI applications.

ABOVE The huge, stunning screen is ideal for professional design and video apps

PC PRO RECOMMENDED

LEFT The bundled S-Pen and Samsung's UI make for a great all-round experience

BELOW An updated MediaTek CPU provides plenty of raw power

The only problem Samsung faces here is that the iPad Air and iPad Pro are even faster. We can't say the Tab S10 Ultra ever felt anything less than ludicrously speedy, but if you must have the absolute fastest hardware, Apple reigns supreme.

But Samsung comes closest to Apple – and even beats it in places – when it comes to the user experience. Not only do you get the S-Pen in the box, perfect for notes and digital art, but Samsung's UI feels slick and intuitive, with excellent support for multitasking. Most of all, Samsung's Dex interface is the best on test for use with keyboard and/or mouse. You can launch, move and resize windows much as you might on a Windows desktop, and the sheer size of the Tab S10 Ultra's screen makes it perfect for serious work. And while you're still hamstrung by the comparative lack of professional apps, the combination of key apps such as Canva and LumaFusion on the one hand and rich web apps for productivity on the other is making this less of an issue.

With such a big screen to work with, it's no surprise that battery life isn't epic, but the Tab S10 Ultra managed a credible 13hrs 45mins in our video-rundown test. It will easily get you through a working day.

The Galaxy Tab S10 Ultra isn't the ideal tablet for everyone. While that huge screen can be advantageous, it can also feel too big when using single apps up close, and it is a bit of a handful. Yet for power users looking for a big canvas they can work on, nothing else comes close.

Battle of the ecosystems

There's no disputing that Apple is the king of the ecosystems, but its rivals are battling hard to catch up

If you already own an iPhone or a Mac, it's a safe bet that you'll buy an iPad if you're after a tablet. That's because Apple has worked consistently over the past 15 years not only to ensure that its products work seamlessly together, but to support them with an ecosystem of software and services that make people's lives easier. And tougher, if they ever choose to leave. Here we provide a rundown of what Apple does, and how some of its rivals are trying to do the same.

Apple

There's a *Matrix*-like feel to Apple's ecosystem. Take the shiny metal pill and slip into a comfortable life. One where you can start an email on an iPad and finish it on your MacBook (Apple calls this feature Handoff), while it's easy to use your iPhone's camera as a webcam when making Slack calls on your Mac mini (Continuity Camera). Things go up a notch if you're using FaceTime, as you can start a call on your iPhone and finish it on your iPad. Don't forget the Apple Watch, either, which does all the usual things you expect from a smartwatch while also acting as a remote control for your iPhone's camera, for instance.

Data sharing is also seamless. Thanks to AirDrop, you don't even need to have an internet connection to share files and photos between your iPad and your Mac, and when you do get back online there's iCloud (you get 5GB of free storage) to act as the universal file system for all your data. Whatever device you're using, you can access photos, documents, videos and app-specific data.

Which brings us to Universal Apps. These are the power apps that are designed to work across the three main hardware platforms – iPhone, iPad, MacBook/Mac – so that you can switch between them at will. They're particularly useful for creative apps where sometimes you need the power of a desktop CPU and other times you want to use a stylus.

When it's time for you to be entertained, Apple has a triple play of services: Apple Music, Apple TV+ and Apple Arcade. Arcade lets you play ad-free games across your devices, including the Apple TV and the Vision Pro. That costs £6.99 per month, while Apple TV+ is £8.99 and Apple Music costs £10.99 (£5.99 for students, £16.99 for a family plan where you can share it with five other people). Apple's real aim is to boost subscriptions to its Apple One platform – £18.95 per month for individuals, £24.95 for a family plan and £36.95 for Premier – which also bundles its Fitness+ subscription and boosts iCloud storage to 2TB.

But even if you choose not to subscribe, there are clearly powerful reasons to stick with the Apple ecosystem. It's set a high benchmark for its rivals.

ABOVE Apple's products all integrate pretty seamlessly

Microsoft

Microsoft is trying to replicate some of what Apple offers, but without tight control over the hardware you're using – and no control at all over Android – it inevitably feels more disjointed. However, it's worth setting up Phone Link on your Windows 10 or 11 system as this will pair with your Android phone or iPhone to open up a few handy features.

Possibly the most useful is that you can take and make calls on your PC, but you can also send text messages and grab photos. That's it, though, with no tie-ins for services or apps, and there's no equivalent Tablet Link.

ABOVE You can pair your mobile with Windows 10 and 11

BELOW Samsung apps can be shared across your devices

Honor and Huawei

Due to their shared ancestry, Honor and Huawei offer a similar set of "ecosystem" capabilities to each other. However, since Huawei's phones and tablets no longer support Android, we'll concentrate here on Honor Connect.

So long as you're signed in using your Honor ID and connected to the same wireless network, you'll be able to share files via drag and drop, answer calls and switch between supported apps in a similar way to Apple. Say you're working on the MagicPad2 but a call comes in on your Honor phone – this will flash up on the tablet's screen, and you can take the call while leaving your phone in your pocket. Likewise if you receive a text while working on your laptop (though this only matches Microsoft's Phone Link).

Perhaps the best feature is the ability to turn your tablet into a secondary display for your Honor laptop. Potentially useful when working in a hotel room, say.

Samsung

Finally we come to Samsung, which can do everything Honor can (using a very similar setup procedure, so you'll need to sign in with your Samsung ID) and a little bit more. For example, Quick Share is there for sharing photos and documents, and if you have a Samsung laptop then activating Multi control means you can use your keyboard and mouse on Galaxy phones or tablets. It's similarly easy to use a Galaxy tablet as a second screen.

If you buy into Samsung Apps (does anyone?) then you can also use these across devices, while Samsung Smart TV owners can easily cast their phone or tablet screen to the larger display of a TV. This comes in most useful if you use Dex, Samsung's desktop environment, and if you also have a Galaxy phone then you can use it as a mouse. We recommend bringing your own Bluetooth keyboard, though.

Amazon Fire HD 8 (2024)

A solid budget option for family use, but it feels as basic as its price suggests

SCORE ★★★☆☆

PRICE 32GB, £83 (£100 inc VAT) **from** amazon.co.uk

Amazon's smallest tablet is one of the most affordable you can buy from a big-name brand, coming in at just £100 inc VAT if you're prepared to put up with annoying ads when you sign in – and even less if you wait for frequent sales. Yet price isn't the only thing it has going for it.

Despite the Fire HD's plastic shell and a lack of branded toughened glass in the screen, it's surprisingly robust, and Amazon has added a subtle, grippy texture to the rear. The chunky bezels around the screen make it look dated and cheap, but it's surprisingly compact, with a 202 x 137mm footprint and a 9.6mm profile meaning it's easy to slip into almost any bag. At 337g you'll barely notice that you're carrying it around.

Still, the low price has meant Amazon has had to make some real compromises. You're stuck with a fairly low 1,280 x 800 resolution, and while this translates to a 189ppi pixel density on an 8in screen, you still don't get the clarity or detail you'd expect from even some fairly inexpensive smartphones. Brightness is up to scratch, maxing out at 425cd/m², but you don't get the same punchy contrast as on the Fire HD 10, let alone the more expensive tablets. Colour reproduction also suffers, with just 76% of the sRGB gamut covered. On the plus side, streaming video is still very watchable outside of darker scenes, while the sound is strangely better than on the bigger Amazon tablet. There's still not much bass or stereo space, but the tone is warmer and more rounded.

ABOVE The cheap and cheerful Fire HD 8 is a great choice for kids

BELOW The plastic shell is fairly robust

Like the Fire HD 10, the Fire HD 8 only supports Wi-Fi 5, making it hard to get a solid connection for video streaming at longer range. Yet its biggest issue is performance. While the new Fire HD 8 has more CPU power and RAM than the previous version, its six-core CPU remains relatively weedy. It's comfortably the slowest device in all our benchmarks, and while you won't notice much difference when streaming Amazon Prime Video or Netflix, you will if you browse with a bunch of tabs open or start trying to run more intensive games or apps.

Battery life is impressive – we measured nearly 19 hours of streaming from a single charge – but this is more a decent, cheap device for content consumption than an effective all-rounder.

Amazon Fire HD 10 (2023)

Good value for entertainment and basic tasks, but it's worth spending more

SCORE ★★★☆☆

PRICE 32GB, £125 (£150 inc VAT) **from** amazon.co.uk

Amazon's larger tablet has its strengths. Say what you like about its plastic construction – available in ocean blue, lilac and black – but it's surprisingly tough and comfortable to hold. You can also accessorise it with a selection of cases, including a chunky "Kid-Proof" case and a keyboard folio. With the latter, it will easily cover school homework and simple web-based tasks.

The screen isn't bad either. Though the gloss surface is annoyingly reflective, the brightness level maxes out at a respectable 437cd/m², and it can reproduce 99% of the sRGB colour space and 73% of DCI-P3. We spent a few hours watching films and prestige TV shows on Amazon Prime Video, and though gloomy scenes could look muddy and HDR effects were lost, the viewing experience wasn't bad at all. You might want to plug in some headphones, though; the sound is thin, weedy and almost entirely bass-free. Thank goodness for the old-school headphones socket, not to mention the handy microSD card slot.

What about the weaknesses? Well, if you're mostly interested in content consumption, neither the underwhelming performance nor the limitations of Amazon's Appstore will cause you any problems. You can pick up all the major music and video streaming apps, and they run well enough on the Fire HD 10. There's not enough 3D horsepower for anything beyond the more basic games, though, and you really want something with more beef for creative or productivity apps. Meanwhile, Wi-Fi is limited to Wi-Fi 5, which might impact your connection and streaming speeds when you're at home.

ABOVE The Fire HD has a surprisingly decent screen

BELOW The tablet is available in a range of attractive colours

Across single-core, multicore and 3D benchmarks, the Fire HD 10 was consistently in the bottom two or three this month. Its biggest success was in our battery-rundown test, where it held up for over 19 hours of 1080p video playback before the screen went blank.

The Fire HD 10 fulfils its role as a basic, family-friendly slate at an affordable price, especially if you can pick it up in one of Amazon's seasonal sales. Yet it still doesn't feel as slick or responsive as more expensive tablets, and the Fire OS software, while easy to use, can be limiting. You might want to spend more.

Amazon Fire Max 11

Easily Amazon's best tablet, but the software and performance hold it back

SCORE ★★★☆☆
PRICE 64GB, £208 (£250 inc VAT)
from amazon.co.uk

The Fire Max 11 is Amazon's premium Fire tablet, coming in above the Fire HD 10 thanks to a faster CPU, an aluminium body and a significantly better screen. It's also the first Fire tablet in years to really focus on productivity, with high-quality peripherals such as a folio-style keyboard case and active stylus.

It certainly feels more expensive than the Fire HD 10, thanks to the robust metal shell and toughened glass front, while the screen is clearly superior. Not only do you get a higher 2,000 x 1,200 resolution, but a brighter 499cd/m² image and higher levels of contrast. It covers 95% of the sRGB colour gamut and 73% of DCI-P3, and while it's no match for the OLED screens of high-end models, it's still great for watching HDR films on Disney+ or Amazon Prime Video. The audio is also a distinct step up in terms of quality, though it starts to sound harsh if you push the volume more than halfway up.

The optional keyboard and stylus aren't quite professional grade, but they're fine for homework purposes or some light office work. Much the same can be said about the Fire Max 11's performance. It's faster than the Fire HD 10, particularly in multicore tests, and gives you a little more 3D graphics horsepower. However, it's still noticeably slower than most of its Android rivals – let alone anything from Apple – and if you don't watch your browser tabs or try to run more demanding applications, you'll still find that it chugs.

Fire OS isn't the best fit for serious work. Split-screen features are rudimentary, with no support for floating windows, and even switching between apps can feel clunky. Many apps you'd take for granted on iPadOS or Android aren't available from Amazon's Appstore, and we had to sideload many of our test apps.

The Fire Max 11 still has two factors in its favour. Battery life is extremely good – it lasted over 19 hours in our video-streaming test – and it's reasonably cheap by the standards of mid-range Android tablets. All the same, it could do with a processor refresh and some key software improvements if Amazon wants to compete with the best in class.

ABOVE The Fire Max 11 is a big step up from Amazon's other tablets

BELOW Fire OS isn't the best choice for productivity tasks

Apple iPad

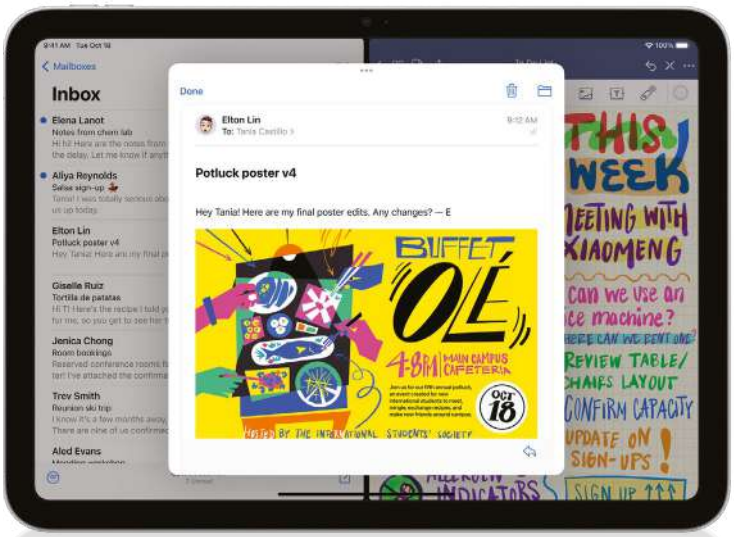
An excellent tablet, and now more affordable, even if the spec has started to date

SCORE ★★★★☆
PRICE 64GB, £274 (£329 inc VAT)
from apple.com/uk

With the price down from £499 to £329, Apple's entry-level iPad is even better value than it was last year. The 10th-generation version has begun to feel like a familiar classic, dropping the Home button and taking cues from the iPad Air to give maximum space for the screen with just enough bezel for comfortable handheld use. It's only 0.9mm thicker, 1.2mm taller and 19g heavier than the mid-range 11in iPad, but you won't notice much difference in a bag or in the hands.

The distinctions become more apparent when you look at the screen and performance, but the iPad's display is excellent for a tablet at this price. It can reach over 500cd/m² in brightness with adaptive brightness on, and it covers 97% of the sRGB colour gamut and 71% of DCI-P3. With an average Delta E of 0.67, colours are accurate enough for professional illustration and design work – and let's not forget that the 10th-generation iPad supports the revised Apple Pencil USB-C. However, the iPad Air gives you deeper blacks and higher levels of contrast; not that you'll notice any deficiencies when bingeing Netflix or playing games on the cheaper model.

As for speed, you can't expect the A14 Bionic to hold up to the M2 and M4 processors in Apple's higher-end iPads, but the iPad still puts the majority of Android tablets to shame in both single-core and multicore CPU performance and 3D graphics. The iPad can handle a wide range of business and creative applications, and it makes a credible vehicle for Apple's extensive games library and Apple Arcade.



Physical connectivity could be better, with the single USB-C port limited to 480Mbits/sec speeds, but you still get Wi-Fi 6 for wireless networking, with the option of 5G. The iPad also scores points for its 12MP front and rear-facing cameras, which take high-quality stills and video with plenty of detail and well-judged exposure for video calls. We'd like to see a processor refresh, so that the iPad could support the new Apple Intelligence features, while battery life could be improved – over 13 hours is fine, but not a spectacular result. But this is still a great affordable all-rounder, and the perfect entry-point into Apple's rich tablet ecosystem.

ABOVE A recent price drop makes the iPad even more affordable

BELOW The display and cameras are a cut above the rest

Google Pixel Tablet

A strong all-rounder, but the mid-range competition is too fierce

SCORE ★★★★☆

PRICE 128GB, £333 (£399 inc VAT)
from store.google.com

You could argue that Google hobbled the Pixel Tablet at launch by insisting on bundling it with its wireless charging speaker dock. There was nothing wrong with the latter's capabilities or audio quality, but now that it's £100 cheaper the Pixel Tablet is definitely an easier sell.

It's a well-designed, compact 11in tablet with a rounded alloy shell coated with a matte faux-ceramic finish, available in an off-white porcelain or grey-green hazel. The connector for the speaker dock is embedded into the shell, and the only other physical connection is a USB-C 3.2 Gen 1 port. At only 8.1mm thick and 493g in weight, it's not as thin and light as the iPad, but is still comfortable to hold and carry.

The IPS screen isn't in the same league as the displays on the Samsung Galaxy Tab S10+ or Apple's iPad Pro and iPad Air, but the 2,560 x 1,600 resolution and 453cd/m² maximum brightness still give you fantastic clarity and detail, with vibrant yet lifelike colours. The display covers 99% of the sRGB colour gamut and 78% of DCI-P3. What's more, the Pixel Tablet puts out a wide and nicely balanced sound; it's not hugely loud, but it is quite dynamic.

While it has Google's Tensor G2 processor to power it, the Pixel Tablet isn't what you'd call a powerhouse. Across our single-core, multicore and GPU benchmarks it finds itself behind the OnePlus Pad 2 and the Honor MagicPad2, let alone the Apple and Samsung leaders. Even in Geekbench AI it falls behind the leading pack.

ABOVE Google's tablet is a well-designed device

BELOW The Pixel Tablet comes with a wireless speaker dock

Yet this tablet still feels slick and speedy in everyday tasks, and Google's Pixel software brings some real advantages in terms of overall usability and AI features, including the Gemini assistant, AI enhancements and the Magic Eraser tool in the Photos app. Google's handling of split-screen multitasking is also slick and versatile, and if you're using a Pixel phone, the familiarity alone might make the Pixel Tablet worth your cash.

The problem here isn't Google's hardware or software, but that the mid-range competition is so fierce. With the OnePlus Pad 2 and MagicPad 2 available at the same price – and Apple's basic iPad £100 less – the Pixel Tablet is a solid buy rather than a great one. All the same, we hope that Google persists with it; a processor refresh and a slightly better screen could make it a serious contender.

Huawei MatePad 12x

More great hardware, but you lose out on performance and Google's services

SCORE ★★★☆☆

PRICE 256GB, £458 (£550 inc VAT)
from consumer.huawei.com/uk

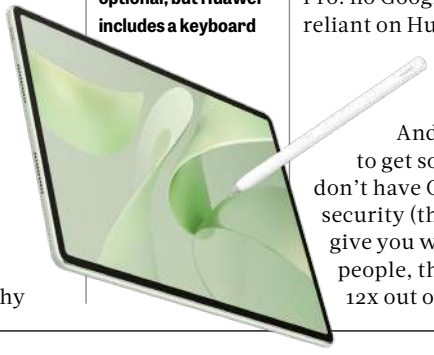
You can see the Huawei MatePad 12x as a trimmed-down version of the company's MatePad Pro 12.2, dropping the spec in places and switching out the lovely OLED screen for an IPS display. Yet it's an interesting mid-range option in its own right, with a sleek design, bundled keyboard and some interesting features.

It's roughly half a millimetre thicker and a few grams heavier than the MatePad Pro, but it still feels like a premium tablet, coming in a choice of white or green pearlescent finishes set off by the odd chrome flourish. A round module on the rear holds the 13MP main camera and 8MP wide-angle lens. Huawei's M-Pencil (usually bundled free) docks and charges on a magnetic section at the top of the tablet used in landscape mode, opposite the volume controls, while the bundled keyboard folio clamps onto the back. Both communicate seamlessly with the tablet via Huawei's NearLink wireless protocol.

The screen matches the 2,800 x 1,840 resolution of the panel in the MatePad Pro, and while you don't get the deep blacks and stunning contrast of the latter's OLED technology, it still goes extremely bright – over 530cd/m² with SDR content in adaptive brightness mode – with a punchy presentation. We measured sRGB coverage at 99% and DCI-P3 at 94%, so colour depth isn't a problem. Colour accuracy isn't perfect, though, with an average Delta E of 2.23 in Normal colour mode.

ABOVE The MatePad 12x has a sleek design and high-res screen

BELOW The stylus is optional, but Huawei includes a keyboard



Performance is close to the MatePad Pro as well, but while the 12x feels slick and smooth in everyday use, even with a dozen browser tabs open, our benchmarks show that its Huawei Kirin CPU can't keep up with the Qualcomm or MediaTek processors found in rival Android devices, especially when it comes to 3D graphics. Battery life is fine, with the MatePad 12x sticking out for even longer than the MatePad Pro – 16hrs 49mins – in our HD video-rundown tests.

There's an awful lot to like about the Huawei MatePad 12x. However, it has the same problem as the MatePad Pro: no Google support means it's reliant on Huawei's services and AppGallery app store. You don't have access to the full range of Android apps, and may have to get some from sources that don't have Google's levels of security (though AppGallery does give you warnings). For many people, this will put the MatePad 12x out of contention.

Lenovo Tab P12 with Matte Display

The paper-like screen is lovely, but the spec doesn't match rivals at this price

SCORE ★★★☆☆

PRICE 128GB, £292 (£350 inc VAT)
from lenovo.com

There's one good reason to buy Lenovo's super-sized tablet, and that's the display. With its 12.7in size and 2,944 x 1,840 resolution, it's big, clear and versatile. Put some time into productivity apps or watch some streaming video, and you'll appreciate the extra space.

Yet the best thing about it is the matte surface, which works with the LTPS screen technology to give you a screen that's closer to paper, soaking up reflections and reducing glare. It's an absolute beauty for reading books, magazines and comics, or simply for checking through business documents, if it comes to that. And while it doesn't go quite as bright as some of the more conventional screens on test, it still holds up well when watching video, thanks to wide viewing angles, decent levels of contrast and rich colours. In tests, it covered 99% of the sRGB colour gamut and 95% of DCI-P3.

It's also nice to see that Lenovo bundles in a stylus. Sure, it doesn't have the sensitivity of Apple's Pencil or Samsung's S-Pen, but it's great for notes and annotations, and it can extend to more arty tasks if pushed. Folio cases and wireless keyboards are also available, and Lenovo's software has a PC mode complete with floating resizeable windows and a taskbar. It's a little clunky with some oversized UI elements, but still an effective way to multitask.

ABOVE The big display soaks up reflections and reduces glare

BELOW The P12 lacks the power of its rivals

Sadly, the rest of the package isn't so impressive. The MediaTek Dimensity 7050 processor will cope with browsing and light creative apps and office tasks, and the 8GB of RAM gives you more headroom than you'll find on budget tablets. Yet single-core and multicore performance in our benchmarks was disappointing, and the P12 lacks the power to run more demanding games. Battery life is also below average, with the Lenovo lasting under 12 hours in our tests. It's a well-built slate and the 610g weight isn't unreasonable given the size, but we'd really like more performance to back up that lovely 12.7in screen.

TCL Nxtpaper 14

A fantastic price for a huge, paper-like screen, but there are compromises elsewhere

SCORE ★★★☆☆

PRICE 256GB, £324 (£389 inc VAT)
from amazon.co.uk

You might lust after the massive screen and cutting-edge features of Samsung's Galaxy Tab S10 Ultra, but what if you lack the budget? TCL hopes it has the answer with the Nxtpaper 14. Not only does it give you a whopping 14.3in display for under £400, but that display allows you to switch at the press of a button between a Regular mode for everyday use and two simulated E Ink modes for reading documents, books and magazines.

This screen has its strengths and weaknesses. It goes reasonably bright at over 400cd/m², and the Ink paper and Color paper modes are reasonably convincing – not quite matching the matte surface and even lighting of the Lenovo P12 with Matte Display, but coming close. Blacks are surprisingly dark and inky, and colours look punchy on the screen. Yet the resolution of 2,400 x 1,600 is a little low for a screen this big, giving you a pixel density of 202ppi. Nor is colour accuracy perfect, with a high average Delta E of 2.86.

The Nxtpaper 14 delivers mixed results elsewhere. The sound, for instance, is pretty good, with a wide stereo spread, some presence and even some bass. The actual build is perfectly solid, with a tough aluminium shell, despite some rough edges around the glass at the front. However, both the rear 13MP camera and the front-facing 8MP camera produce grainy images, while video smears on movement if the lighting isn't bright. You're limited to Wi-Fi 5 for wireless networking and a slow USB-C 2 port. And while TCL claims that the Nxtpaper 14 has 16GB (or 8+8GB) of RAM, all this really means is that it can use 8GB of storage as a fast RAM cache.

ABOVE The paper-like screen is perfect for reading documents

BELOW Sadly, the tablet's performance is below par

Most seriously, performance is distinctly below average. You'd have to look to the budget Amazon Fire HD devices to find anything slower in Geekbench 6, and while the Nxtpaper 14's MediaTek Helio G99 processor and PowerVR GPU help it pull ahead in 3DMark and GFXBench, it's nobody's idea of a games machine. Stick to browsing and media consumption and you're not going to have any problems, but this isn't a great device for anything approaching work, and the battery life is underwhelming. While the big screen and its ingenious features raise hopes for a budget productivity monster, the Nxtpaper just hasn't got the beef to match.

How we test

We ran each tablet through a fearsome set of benchmarks, starting with Geekbench 6 to test CPU performance. The single-core tests put each device's most powerful core to the test, while the multicore tests check performance across all cores. We also run Geekbench's Compute benchmark to get a measure of the onboard GPU in computational tasks.

Synthetic benchmarks don't cover everything, though, which is why we also run a selection of browser-based benchmarks. BaseMark Web 3 and WebXPRT 4 run through a range of productivity, maths and graphics tasks, stretching the CPU and GPU. Meanwhile, JetStream 2 and Kraken give a good indication of how tablets will cope with complex JavaScript and WebAssembly code.

We also use 3DMark and GFXBench to put the GPU through its paces and establish an idea of baseline games performance. We've also experimented with the new Geekbench AI benchmark, testing the AI-processing capabilities of both the CPU and any NPU.

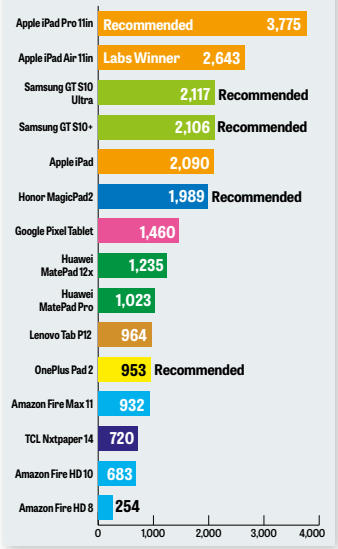
Our screen tests cover colour gamut coverage and accuracy (looking for a low average Delta E). We also look at brightness and contrast levels, though OLED screens are effectively perfect here. We publish how much of the crucial DCI-P3 colour space each screen covers, which movie lovers should note as it's favoured by filmmakers. We also test coverage of the more conservative sRGB gamut.

Finally, our battery rundown test repeatedly plays a 1080p video file with the brightness of the display set to a standard 170cd/m² until the tablet goes into shutdown. We then measure how far each tablet can recharge in 30 minutes.

On top of all these formal tests, we use each tablet extensively for document editing, content creation, video streaming and gaming, to see how each measures up in real-world use.

Speed tests

Geekbench 6 (single core)


Apple iPad Pro 11in Recommended 3,775
Apple iPad Air 11in Labs Winner 2,643
Samsung GT S10 Ultra 2,117 Recommended
Samsung GT S10+ 2,106 Recommended
Apple iPad 2,090
Honor MagicPad2 1,989 Recommended
Google Pixel Tablet 1,460
Huawei MatePad 12x 1,235
Huawei MatePad Pro 1,023
Lenovo Tab P12 964
OnePlus Pad 2 953 Recommended
Amazon Fire Max 11 932
TCL Nxtpaper 14 720
Amazon Fire HD 10 683
Amazon Fire HD 8 254
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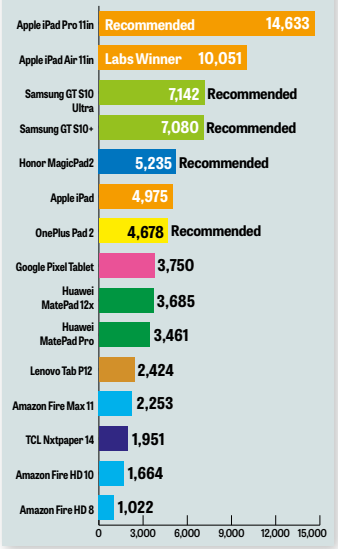
Geekbench 6 (multicore)


Apple iPad Pro 11in Recommended 14,633
Apple iPad Air 11in Labs Winner 10,051
Samsung GT S10 Ultra 7,142 Recommended
Samsung GT S10+ 7,080 Recommended
Honor MagicPad2 5,235 Recommended
Apple iPad 4,975
OnePlus Pad 2 4,678 Recommended
Google Pixel Tablet 3,750
Huawei MatePad 12x 3,685
Huawei MatePad Pro 3,461
Lenovo Tab P12 2,424
Amazon Fire Max 11 2,253
TCL Nxtpaper 14 1,951
Amazon Fire HD 10 1,664
Amazon Fire HD 8 1,022
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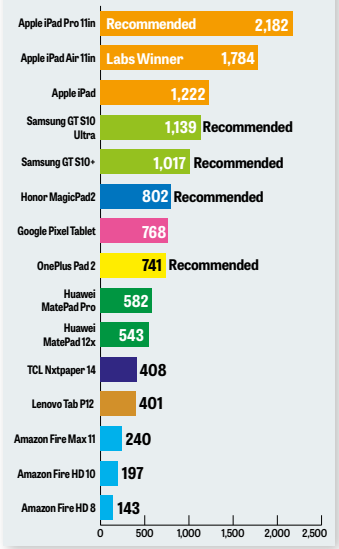
BaseMark


Apple iPad Pro 11in Recommended 2,182
Apple iPad Air 11in Labs Winner 1,784
Apple iPad 1,222
Samsung GT S10 Ultra 1,139 Recommended
Samsung GT S10+ 1,017 Recommended
Honor MagicPad2 802 Recommended
Google Pixel Tablet 768
OnePlus Pad 2 741 Recommended
Huawei MatePad Pro 582
Huawei MatePad 12x 543
TCL Nxtpaper 14 408
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Amazon Fire Max 11 240
Amazon Fire HD 10 197
Amazon Fire HD 8 143
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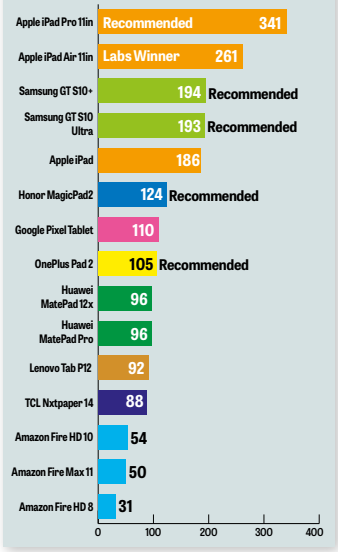
WebXPRT 4


Apple iPad Pro 11in Recommended 341
Apple iPad Air 11in Labs Winner 261
Samsung GT S10+ 194 Recommended
Samsung GT S10 Ultra 193 Recommended
Apple iPad 186
Honor MagicPad2 124 Recommended
Google Pixel Tablet 110
OnePlus Pad 2 105 Recommended
Huawei MatePad 12x 96
Huawei MatePad Pro 96
Lenovo Tab P12 92
TCL Nxtpaper 14 88
Amazon Fire HD 10 54
Amazon Fire Max 11 50
Amazon Fire HD 8 31
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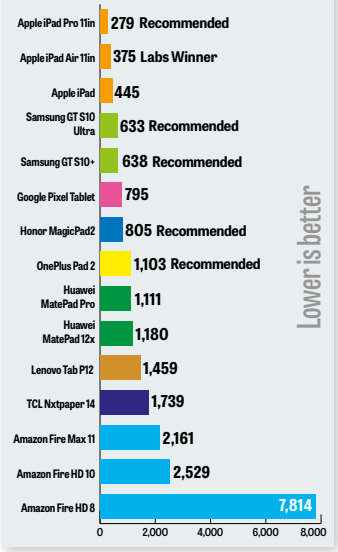
Kraken 1.1


Apple iPad Pro 11in 279 Recommended
Apple iPad Air 11in 375 Labs Winner
Apple iPad 445
Samsung GT S10 Ultra 633 Recommended
Samsung GT S10+ 638 Recommended
Google Pixel Tablet 795
Honor MagicPad2 805 Recommended
OnePlus Pad 2 1,103 Recommended
Huawei MatePad Pro 1,111
Huawei MatePad 12x 1,180
Lenovo Tab P12 1,459
TCL Nxtpaper 14 1,739
Amazon Fire Max 11 2,161
Amazon Fire HD 10 2,529
Amazon Fire HD 8 7,814
Lower is better
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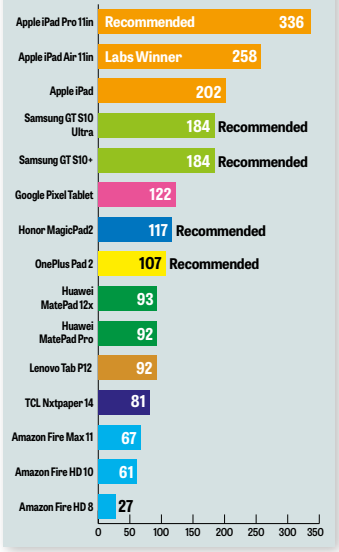
JetStream 2


Apple iPad Pro 11in Recommended 336
Apple iPad Air 11in Labs Winner 258
Apple iPad 202
Samsung GT S10 Ultra 184 Recommended
Samsung GT S10+ 184 Recommended
Google Pixel Tablet 122
Honor MagicPad2 117 Recommended
OnePlus Pad 2 107 Recommended
Huawei MatePad 12x 93
Huawei MatePad Pro 92
Lenovo Tab P12 92
TCL Nxtpaper 14 81
Amazon Fire Max 11 67
Amazon Fire HD 10 61
Amazon Fire HD 8 27
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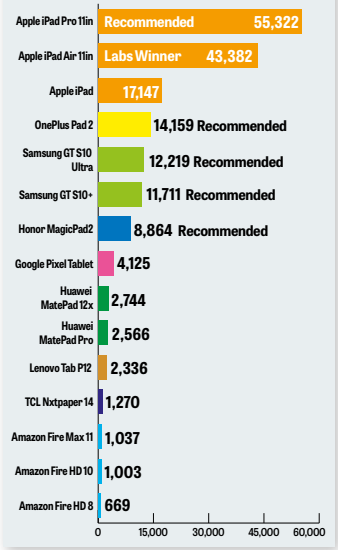
Gaming/3D tests

Geekbench Compute (OpenCL)


Apple iPad Pro 11in Recommended 55,322
Apple iPad Air 11in Labs Winner 43,382
Apple iPad 17,147
OnePlus Pad 2 14,159 Recommended
Samsung GT S10 Ultra 12,219 Recommended
Samsung GT S10+ 11,711 Recommended
Honor MagicPad2 8,864 Recommended
Google Pixel Tablet 4,125
Huawei MatePad 12x 2,744
Huawei MatePad Pro 2,566
Lenovo Tab P12 2,336
TCL Nxtpaper 14 1,270
Amazon Fire Max 11 1,037
Amazon Fire HD 10 1,003
Amazon Fire HD 8 669
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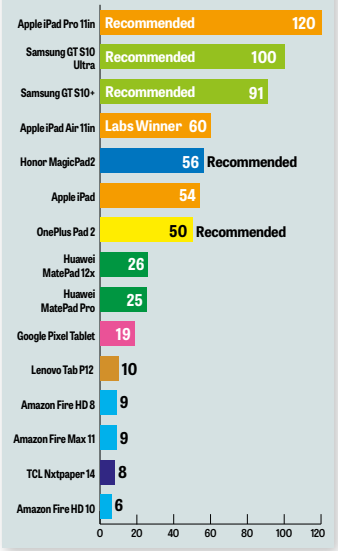
GFXBench Aztec Ruins (Vulkan/Metal Normal fps)


Apple iPad Pro 11in Recommended 120
Samsung GT S10 Ultra Recommended 100
Samsung GT S10+ Recommended 91
Apple iPad Air 11in Labs Winner 60
Honor MagicPad2 56 Recommended
Apple iPad 54
OnePlus Pad 2 50 Recommended
Huawei MatePad 12x 26
Huawei MatePad Pro 25
Google Pixel Tablet 19
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Amazon Fire Max 11 9
TCL Nxtpaper 14 8
Amazon Fire HD 10 6
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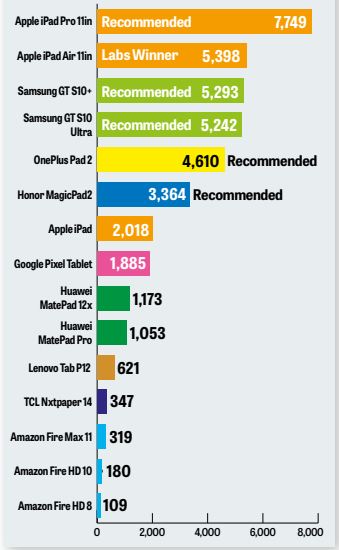
3DMark Wild Life Extreme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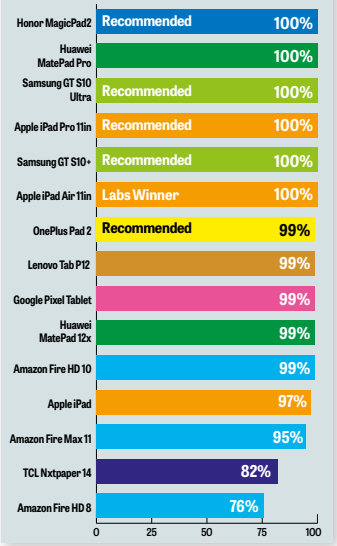
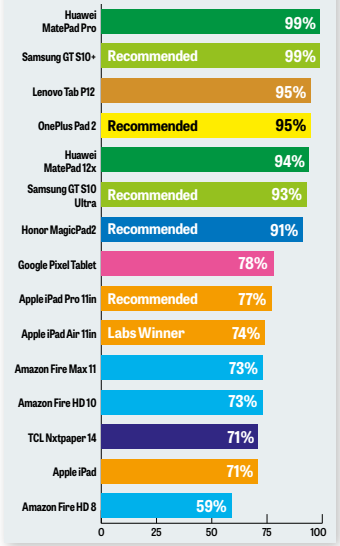
Apple iPad Air 11in Labs Winner 5,398
Samsung GT S10+ Recommended 5,293
Samsung GT S10 Ultra Recommended 5,242
OnePlus Pad 2 4,610 Recommended
Honor MagicPad2 3,364 Recommended
Apple iPad 2,018
Google Pixel Tablet 1,885
Huawei MatePad 12x 1,173
Huawei MatePad Pro 1,053
Lenovo Tab P12 621
TCL Nxtpaper 14 347
Amazon Fire Max 11 319
Amazon Fire HD 10 180
Amazon Fire HD 8 109
0 2,000 4,000 6,000 8,000

Display tests

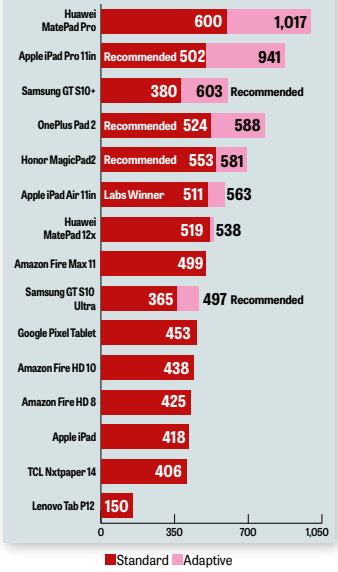
sRGB coverage


Honor MagicPad2 Recommended 100%
Huawei MatePad Pro 100%
Samsung GT S10 Ultra Recommended 100%
Apple iPad Pro 11in Recommended 100%
Samsung GT S10+ Recommended 100%
Apple iPad Air 11in Labs Winner 100%
OnePlus Pad 2 Recommended 99%
Lenovo Tab P12 99%
Google Pixel Tablet 99%
Huawei MatePad 12x 99%
Amazon Fire HD 10 99%
Apple iPad 97%
Amazon Fire Max 11 95%
TCL Nxtpaper 14 82%
Amazon Fire HD 8 76%
0 25 50 75 100

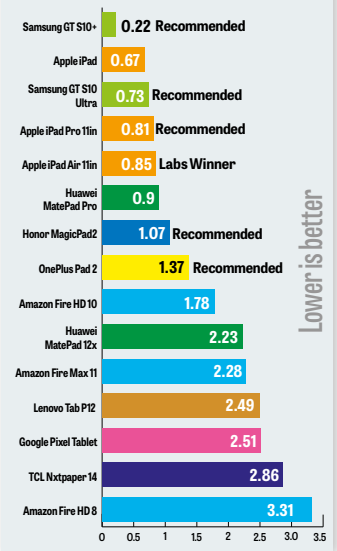
DCI-P3 coverage


Huawei MatePad Pro 99%
Samsung GT S10+ Recommended 99%
Lenovo Tab P12 95%
OnePlus Pad 2 Recommended 95%
Huawei MatePad 12x 94%
Samsung GT S10 Ultra Recommended 93%
Honor MagicPad2 Recommended 91%
Google Pixel Tablet 78%
Apple iPad Pro 11in Recommended 77%
Apple iPad Air 11in Labs Winner 74%
Amazon Fire Max 11 73%
Amazon Fire HD 10 73%
TCL Nxtpaper 14 71%
Apple iPad 71%
Amazon Fire HD 8 59%
0 25 50 75 100

Peak brightness (SDR cd/m²)

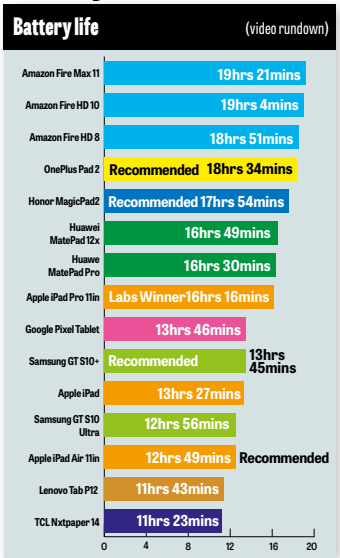

Huawei MatePad Pro 600 1,017
Apple iPad Pro 11in Recommended 502 941
Samsung GT S10+ 380 603 Recommended
OnePlus Pad 2 Recommended 524 588
Honor MagicPad2 Recommended 553 581
Apple iPad Air 11in Labs Winner 511 563
Huawei MatePad 12x 519 538
Amazon Fire Max 11 499
Samsung GT S10 Ultra 365 497 Recommended
Google Pixel Tablet 453
Amazon Fire HD 10 438
Amazon Fire HD 8 425
Apple iPad 418
TCL Nxtpaper 14 406
Lenovo Tab P12 150
0 350 700 1,050
Standard Adaptive

Average Delta E

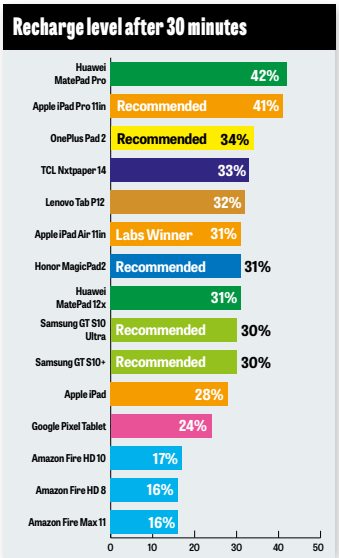

Samsung GT S10+ 0.22 Recommended
Apple iPad 0.67
Samsung GT S10 Ultra 0.73 Recommended
Apple iPad Pro 11in 0.81 Recommended
Apple iPad Air 11in 0.85 Labs Winner
Huawei MatePad Pro 0.9
Honor MagicPad2 1.07 Recommended
OnePlus Pad 2 1.37 Recommended
Amazon Fire HD 10 1.78
Huawei MatePad 12x 2.23
Amazon Fire Max 11 2.28
Lenovo Tab P12 2.49
Google Pixel Tablet 2.51
TCL Nxtpaper 14 2.86
Amazon Fire HD 8 3.31
Lower is better
0 0.5 1 1.5 2 2.5 3.0 3.5

Battery tests

Battery life (video rundown)

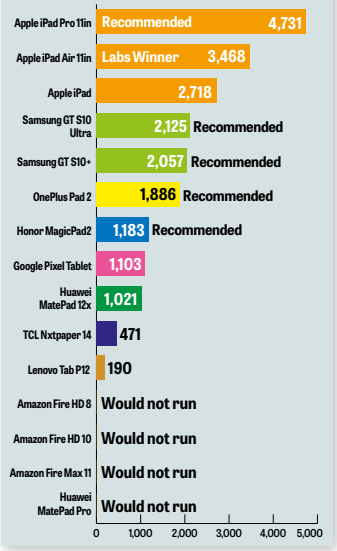

Amazon Fire Max 11 19hrs 21mins
Amazon Fire HD 10 19hrs 4mins
Amazon Fire HD 8 18hrs 51mins
OnePlus Pad 2 Recommended 18hrs 34mins
Honor MagicPad2 Recommended 17hrs 54mins
Huawei MatePad 12x 16hrs 49mins
Huawe MatePad Pro 16hrs 30mins
Apple iPad Pro 11in Labs Winner 16hrs 16mins
Google Pixel Tablet 13hrs 46mins
Samsung GT S10+ Recommended 13hrs 45mins
Apple iPad 13hrs 27mins
Samsung GT S10 Ultra 12hrs 56mins
Apple iPad Air 11in 12hrs 49mins Recommended
Lenovo Tab P12 11hrs 43mins
TCL Nxtpaper 14 11hrs 23mins
0 4 8 12 16 20

Recharge level after 30 minutes


Huawei MatePad Pro 42%
Apple iPad Pro 11in Recommended 41%
OnePlus Pad 2 Recommended 34%
TCL Nxtpaper 14 33%
Lenovo Tab P12 32%
Apple iPad Air 11in Labs Winner 31%
Honor MagicPad2 Recommended 31%
Huawei MatePad 12x 31%
Samsung GT S10 Ultra Recommended 30%
Samsung GT S10+ Recommended 30%
Apple iPad 28%
Google Pixel Tablet 24%
Amazon Fire HD 10 17%
Amazon Fire HD 8 16%
Amazon Fire Max 11 16%
0 10 20 30 40 50

AI tests

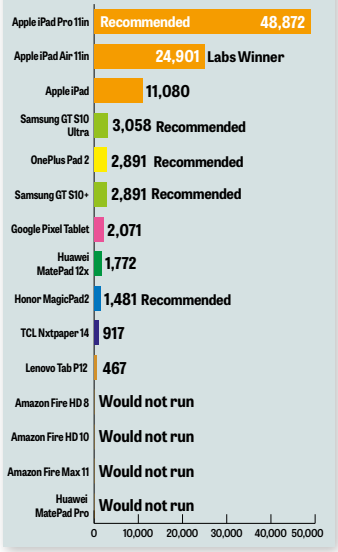
Geekbench AI CPU (full)


Apple iPad Pro 11in Recommended 4,731
Apple iPad Air 11in Labs Winner 3,468
Apple iPad 2,718
Samsung GT S10 Ultra 2,125 Recommended
Samsung GT S10+ 2,057 Recommended
OnePlus Pad 2 1,886 Recommended
Honor MagicPad2 1,183 Recommended
Google Pixel Tablet 1,103
Huawei MatePad 12x 1,021
TCL Nxtpaper 14 471
Lenovo Tab P12 190
Amazon Fire HD 8 Would not run
Amazon Fire HD 10 Would not run
Amazon Fire Max 11 Would not run
Huawei MatePad Pro Would not run
0 1,000 2,000 3,000 4,000 5,000

Geekbench AI CPU (half)

Apple iPad Pro 11in Recommended 35,153
Apple iPad Air 11in 23,135 Labs Winner
Apple iPad 11,554
Samsung GT S10 Ultra 2,126 Recommended
OnePlus Pad 2 2,108 Recommended
Samsung GT S10+ 2,047 Recommended
Google Pixel Tablet 1,115
Honor MagicPad2 1,043 Recommended
Huawei MatePad 12x 1,028
TCL Nxtpaper 14 484
Lenovo Tab P12 187
Amazon Fire HD 8 Would not run
Amazon Fire HD 10 Would not run
Amazon Fire Max 11 Would not run
Huawei MatePad Pro Would not run
0 10,000 20,000 30,000 40,000

Geekbench AI CPU (quantised)


Apple iPad Pro 11in Recommended 48,872
Apple iPad Air 11in 24,901 Labs Winner
Apple iPad 11,080
Samsung GT S10 Ultra 3,058 Recommended
OnePlus Pad 2 2,891 Recommended
Samsung GT S10+ 2,891 Recommended
Google Pixel Tablet 2,071
Huawei MatePad 12x 1,772
Honor MagicPad2 1,481 Recommended
TCL Nxtpaper 14 917
Lenovo Tab P12 467
Amazon Fire HD 8 Would not run
Amazon Fire HD 10 Would not run
Amazon Fire Max 11 Would not run
Huawei MatePad Pro Would not run
0 10,000 20,000 30,000 40,000 50,000

View from the Labs

As top-end devices edge closer to laptops, is it time to rethink the tablet?

Tablets keep evolving. I used to dismiss low-end models due to their terrible screens and crippled processors, but the experience is now far from terrible. But the biggest change has been at the higher end, where I've seen a blossoming of larger form factors and the arrival of laptop-class silicon.

We're getting to the point where these tablets could work as your daily driver. Apple and Samsung have aspired to this for years, but now the hardware, accessories and ecosystems have made it practicable. I'm not saying it's perfect. You still face limitations in terms of the interface or file system that make some tasks challenging, but the iPad Air, iPad Pro or Galaxy Tab S devices can now easily handle video editing or professional design work. Sure, you might stick to your desktop for heavy-duty tasks, but when on the move a tablet has advantages over a conventional laptop due to that touchscreen. In terms of my daily workloads, there's not much I couldn't achieve on these superpowered slates, or even on the mid-range OnePlus Pad 2 and Honor MagicPad2.

We're also seeing the dawn of what AI might do for tablets. Text generation, voice and handwriting recognition, document summarisation, audio transcription, image generation and AI editing features only become more useful on devices where you're working with a touchscreen or a stylus. AI could take tablets on their evolution into becoming powerful business tools.

The technology will take time to mature and – as in the PC space – we'll see a lot of spurious claims before these features become consistently useful. But with Apple Intelligence on the way and Google and Samsung's AI tech becoming more established, that might happen sooner than you think. ●

Stuart Andrews is a former reviews editor of *PC Pro* and a long-time tablet addict

Buyer's guide

Videoconferencing buyer's guide 2024

Equip your meeting rooms with products that will keep your team happy, whether in-office, remote or hybrid

Remote and flexible working continue to grow in popularity and videoconferencing (VC) has had a huge part to play in its success. It provides the tools for employees and customers to easily communicate and collaborate regardless of their physical location.

Growth is expected to increase, and board room dinosaurs that think otherwise should make sure they're aware of the UK government's Flexible Working Bill, which came into force in April this year. This gives employees a day-one right to request flexible working, with employers required to consider any request and provide a reason before rejection.

Forward-thinking companies will find plenty of sophisticated VC solutions on the market, with options ranging from small round-table meetings and huddle spaces up to larger meeting rooms and conference spaces. Competition between manufacturers is good news for SMBs, too, as this is driving prices down.

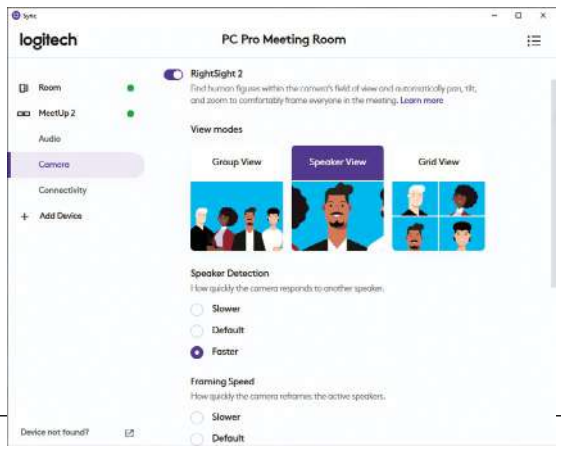
In this month's guide, we review four business-class meeting room systems from Biamp, Logitech, Owl Labs and Ricoh. We've selected a range of solutions suited to different environments and tested them in the lab to help you make the right choice.

Room service

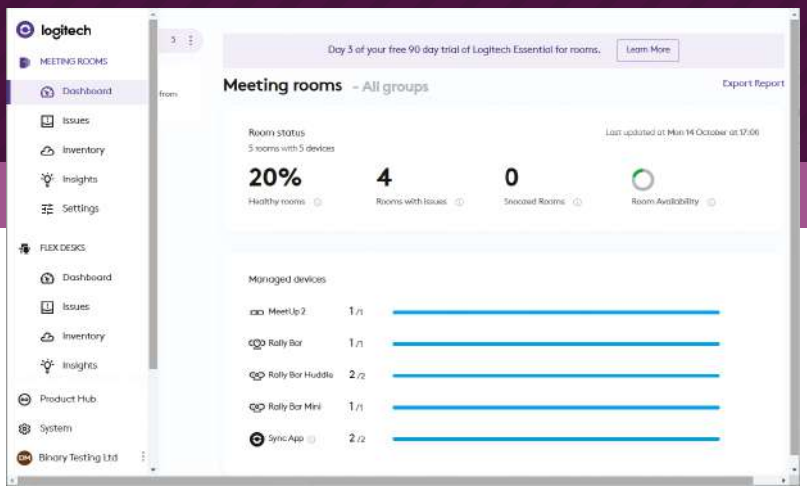
With so many different VC solutions to choose from, it's important to understand what each type does and what benefits they can bring to your business. If you want to create a dedicated meeting room, all-in-one video bars are a good choice as they offer everything you need in one easily installed device.

The latest VC bars combine a high-quality 4K UHD camera with integral speakers and microphone arrays, so all you need to do is decide where to mount them. Most only require power and a USB cable so you can use a host computer permanently set up in the room or allow BYOD users to connect their own laptop and run their VC app of choice.

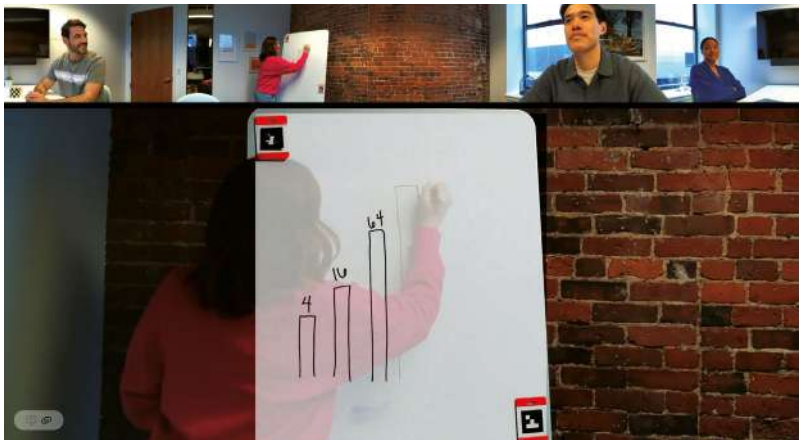
Standalone VC bars do away with the need for a host computer as they run an embedded OS, such as Android, that allows them to host a range of certified on-board VC apps. Users don't need to



BELOW Logitech's MeetUp 2 can be locally configured using its Sync app



LEFT **Logitech's Sync cloud portal provides remote management for the MeetUp 2**



LEFT **The Whiteboard Owl's presenter transparency is a very clever feature**

bring anything with them and can start a meeting with a few taps using the bar's onscreen menus or optional touchscreen controllers.

The size of the meeting room will determine which VC bar is suitable, and you should check their datasheets to see what their microphone pickup range is. Loudspeakers are important, too: VC bars with single speakers are best suited to small meeting rooms or huddle spaces whereas larger rooms will need one with twin speakers.

The only component you'll need to source yourself is a meeting room monitor, and it could be more cost-effective to pair your video bar with a 4K monitor. With so few VC providers supporting 4K on their meeting apps this may seem an unnecessary extravagance, but prices for these monitors are becoming ever more affordable and you'll be future-proofing your meeting room. Microsoft Teams Rooms on Windows, for example, supports 4K monitors for in-room displays but, as with most other VC apps, it still has 4K video streaming on the drawing board.

Sound chaser

It can be time consuming positioning the camera so everyone is in shot, but a smart feature present in all good VC systems is designed to solve this. They use their multiple microphones to create a beamforming array that works out where the person speaking is physically located in the room and focuses the camera on them. One video bar in this guide has no fewer than 27 microphones for highly accurate tracking.

This makes meetings more dynamic as instead of staying in one position, participants can move around the room while speaking and the camera will follow them. We recommend cameras that use digital pan, tilt and zoom (PTZ) functions as these respond much faster to movement than older devices with mechanical systems that have to physically move the lens.

Split-screen technology is another feature to look for, as this can make meetings even more immersive. Instead of focusing only on one person, the camera can dynamically split the screen or use a grid to show all the most recent speakers.

Other valuable features are audio processing technologies that are designed to enhance the sound quality of meetings. These can significantly improve the experience by identifying human voices and filtering out unwanted noise such as keyboard clacking or paper shuffling, allowing remote participants to hear the speaker more clearly.

"Smaller businesses that don't have the luxury of a dedicated room may want to consider a VC hub"

Chance meeting

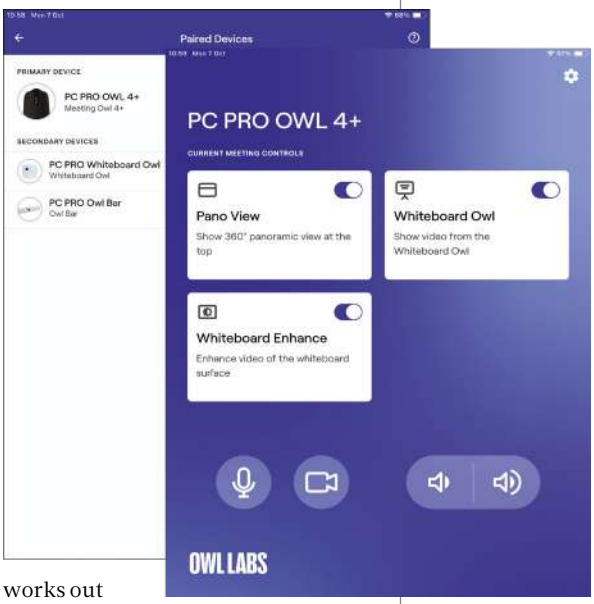
Smaller businesses that don't have the luxury of a dedicated room may want to consider a VC hub, which can turn any convenient space into an impromptu meeting. Designed to be portable, these cylindrical devices use fish-eye lenses or multiple cameras to provide a full 360-degree view and, as with VC bars, have integrated speakers and microphone arrays.

These attributes make them great for round-table meetings as everyone is in view and their audio systems provide all-round sound and microphone pickup ranges. Just place the device in the middle of a table, add power, plug it in to a host computer's USB port and you're ready to go.

Some are even more sophisticated than room bars. They can use their cameras and microphone arrays to create a 360-degree panoramic view at the top with dynamically changing views of recent speakers below.

No meeting room should be without a whiteboard, and some vendors offer optional cameras that can bring them into the main view. A smart feature that's bound to impress is "presenter transparency": when a person stands in front of the board, all participants can still see everything on it.

Videoconferencing has a vital role to play in today's hybrid workplaces, and the incredible range of products means there's an affordable solution for every business. In the following pages, we review a variety of VC room bars and hubs, so turn the page to see which one will best connect your flexible workforce.



ABOVE **The Meeting Owl 4+, Bar and Whiteboard Owl can be paired using an app**

Biamp Parlé VBC 2800

Ideal for big meeting rooms, the VBC 2800 combines top video and audio quality with innovative speaker tracking

SCORE ★★★★★

PRICE £2,918 exc VAT (MSRP)
from midwich.com

When Biamp launched its Parlé VBC 2500 (*see issue 347, p102*), it set new standards for videoconferencing. This mighty all-in-one room bar delivered a stunning range of features. It continues to target small to medium-sized meeting rooms, but Biamp wanted to go further and has introduced the VBC 2800, which is aimed at larger conference rooms up to 8.5 metres in length.

The VBC 2800 gets the benefit of two 4K cameras. For distance vision, it has a 50MP wide-angle lens that supports a 16x digital zoom, while an 8MP ultrawide-angle lens with a 3x zoom handles close-up work.

This lens combo is designed to support longer meeting room tables and make Biamp's speaker tracking even more efficient. It uses the high-resolution lens to focus on active speakers at the far end of the table and seamlessly switches to the ultrawide-angle one for participants seated at the side and closer to the room bar.

The VBC 2800 uses the same highly accurate beam-tracking array as the VBC 2500, and comprises 27 microphone elements. These create three zones in front of the room bar: two 65° zones for each side of the table and a 40° zone down the centre line.

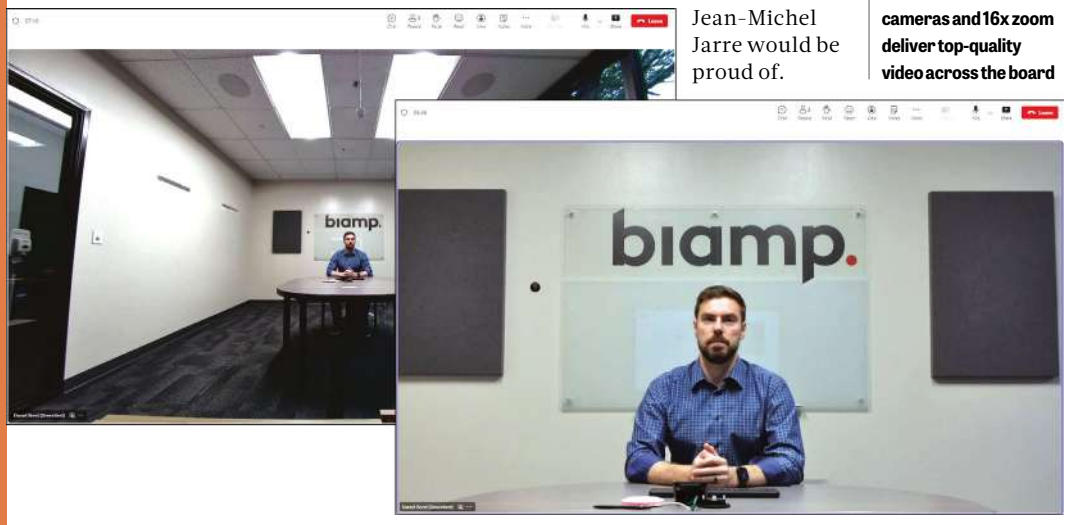
The array uses vertical and horizontal tracking so it can compensate for different mounting locations and track people regardless of whether they're sitting or standing. The VBC 2800 also employs Biamp's audio intelligence, which uses machine learning algorithms to identify and isolate human voices and remove distracting background noises.

There's no need to worry about audio configuration as you position the bar in the desired location and press the Launch button on its underside. Brace yourself on first contact, as it introduces itself with a very loud drum roll and then measures the room's acoustics by emitting a series of electronic sounds that Jean-Michel Jarre would be proud of.

ABOVE The VBC 2800 is perfect for large meeting rooms

LEFT Two 4K cameras produce outstanding video quality

"Video quality is great, with a sharply focused image, good contrast and efficient backlight compensation"



BELOW The dual cameras and 16x zoom deliver top-quality video across the board

The VBC 2800 comes with a solid integral desk stand as well as a wall bracket, and Biamp offers an optional PMA 2000-DM display mount. Behind the removable rear panel is an external power socket plus a USB-C host connection port; the extra Ethernet port is ready for Biamp's upcoming Workplace cloud management platform.

Installation is swift. We connected the room bar to a Windows 11 host PC and waited a few seconds while it loaded the drivers. The VBC 2800 is fully compliant with UVC (USB video class) so it will work with just about any VC app, and we had no problems with Microsoft Teams, Zoom or Skype.

The cameras have fast reaction times and easily tracked speakers as they moved around our 24m² meeting room with delays of no more than two seconds. Video quality is great with a sharply focused image, good contrast and efficient backlight compensation.

The VBC 2800 uses the same pair of sealed 20W speakers as Biamp didn't feel the need to improve on these. It isn't wrong, as these deliver incredibly good sound quality that's maintained right up to (a very loud) maximum volume.

Biamp's Camera Controller app is included for manually controlling PTZ functions, flipping or mirroring the image and disabling auto-framing and backlight compensation. Three quick access presets can be created, and it offers UC profiles to optimise the system for Microsoft Teams, Google Meet and Zoom.

We thought the VBC 2500 was a great VC room bar, and the new VBC 2800 delivers Biamp's undeniable expertise to larger meeting rooms. Video and audio quality are outstanding, speaker framing is super-fast and the smart combination of dual camera lenses makes sure everyone is in the big picture.

SPECIFICATIONS

50MP wide-angle lens • 8MP ultrawide-angle lens • 2160p at 30fps • max 150° FoV • digital PTZ • 16x/3x zoom • 2 x 20W speakers • 27-element beam-tracking array • USB-C 3.2 Gen 1 • 10/100 Ethernet (future use) • external PSU • 940 x 64 x 100mm (WDH) • 4.4kg • Camera Controller app for Windows and macOS • 3yr limited warranty

Logitech MeetUp 2

An affordable VC bar for small rooms with great video quality and excellent cloud management services

SCORE ★★★★☆

PRICE £625 exc VAT
from visunext.co.uk

Launched over seven years ago, Logitech's original MeetUp VC bar (*see issue 279, p105*) was designed for small meeting rooms and, at the time, was one of the first to sport a 4K UHD lens. The MeetUp 2 takes some of the features we liked from its predecessor and brings it bang up to date.

It retains the 4K lens and big diagonal 120° field of view (FoV) but moves over to digital pan, tilt and zoom (PTZ) operations. The MeetUp 2 actually has more in common with Logitech's higher-end Rally Bar Huddle (*see issue 352, p98*) – although it's slightly smaller, it has the same six MEMS microphone beamforming array for speaker tracking and single 55mm 8W ported speaker.

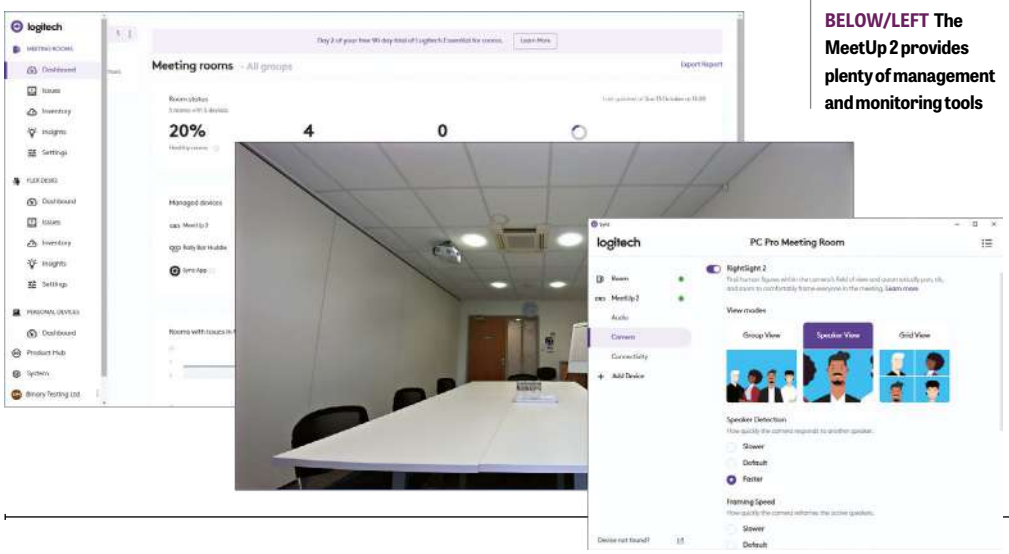
Behind the rear cable-tidy panel, you'll find a single USB-C and dual HDMI ports. Network features are good: it supports gigabit wired and Wi-Fi 5 connections, presents a web browser console and can be remotely managed from Logitech's Sync cloud portal.

Unlike the larger Rally Bars, the MeetUp 2 offers only two operational modes: you can connect it to a dedicated room computer or let users bring their own device and load the VC app of their choice. It runs Logitech's Android-based CollabOS but doesn't support its standalone appliance mode.

The MeetUp 2 defaults to enabling its web interface and displays login details on an attached monitor. You'll need to change the admin password within 48 hours otherwise it will be disabled for security purposes, but pressing the rear reset button for five seconds reactivates it.

A wired network connection is the easiest to use as the wireless setup must initially be accessed over Bluetooth from Logitech's Sync Installer mobile app. On first contact with the web console, you run through a wizard-guided setup and choose BYOD or Appspace modes, with the latter used to display digital signage when the camera is idle.

LEFT The 4K lens has a big diagonal 120° field of view



BELOW/LEFT The MeetUp 2 provides plenty of management and monitoring tools

ABOVE The MeetUp 2 is an affordable choice for smaller rooms

Load the Sync app on the host computer and you can access audio and video settings, run firmware upgrades and enable Logitech's RightSight 2 video enhancement technology, which offers Group, Speaker and Grid views. Adding the MeetUp 2 to your Sync cloud account opens up full remote management and room usage analytics.

In BYOD mode, we connected a Windows 11 host to the bar's HDMI-in port and an HD monitor to its HDMI-out port and had no problems using our local Teams, Skype and Zoom VC apps. The MeetUp 2 delivers great 1080p video quality, with a sharply focused image, good colour balance and effective backlight compensation.

> **"The MeetUp 2 delivers great 1080p video quality, with a sharply focused image, good colour balance and effective backlight compensation"**

Speaker tracking isn't the fastest we've seen, with the MeetUp 2 taking up to four seconds to latch onto the active speaker. but it's still a lot quicker than Logitech's mechanical Rally Bars. Audio output is fine for small meeting rooms and Logitech's integrated RightSound 2 worked well with remote participants saying they could hear us clearly even when we were four metres from the bar.

Support for DisplayPort Alt mode makes for fast BYOD connections, and we tested this using Logitech's optional five-metre active USB cable to connect the MeetUp 2 to a Windows 11 PC with a DP-compatible USB port. We didn't need to do anything else as the MeetUp 2 automatically swapped over to the PC's screen allowing us to run meetings using our VC app of choice.

Costing around half that of a Rally Bar Huddle, the MeetUp 2 is an affordable choice for businesses that want a small meeting room solution without the expense of standalone mode. Speaker tracking is a little slow, but image quality is superb and Logitech's Sync cloud service delivers great remote management.

SPECIFICATIONS

4K UHD camera ● max 1080p ● 120° FoV ● digital PTZ (4x zoom) ● 6 x MEMS beamforming mic array ● 55mm 8W ported speaker ● Gigabit ● Wi-Fi 5 ● HDMI out, HDMI in ● USB-C 3.2 Gen 1 ● external PSU ● 469 x 73 x 73mm (WDH) ● 1.8kg ● 2yr hardware warranty.
Options: 5m active USB cable, £142 exc VAT

Owl Labs Medium Room Solution

This team of products is perfect for larger meeting rooms and delivers astonishingly good visuals

PC PRO RECOMMENDED

SCORE ★★★★★

PRICE Owl 4+, Owl Bar, TV mount, £2,999 exc VAT **from** owllabs.co.uk

Owl Labs Meeting Owl 4+ camera bowled us over when we first tested it (*see issue 360, p102*) as it's one of the cleverest VC solutions we've yet seen. Its 360° panoramic and dynamic split-screen views makes it perfect for small meeting rooms, round tables or huddle spaces, and teaming it up with an Owl Labs Owl Bar extends this expertise to medium-sized rooms.

The optional Whiteboard Owl adds yet another dimension to meetings. Positioned next to your room monitor, it displays a whiteboard located up to five metres away and uses its 1080p camera and clever presenter transparency feature to overlay it on to the main camera view.

The beauty of this VC system is that you only need to connect the primary unit to a host PC and power to the rest; the Owl 4+ and Owl Bar are paired using Bluetooth, while the Whiteboard Owl links up over Wi-Fi. They all work together to automatically provide the best meeting room views, and video and audio management is carried out from the Owl Labs mobile or Windows and macOS apps so there's no remote control handset to lose.

The Owl 4+ and Owl Bar can both work as standalone units, but bringing them together makes meetings a lot more interesting. We started by connecting the Owl 4+ to a Windows 11 host PC over its USB-C port, where it loaded all required drivers and defaulted to the split-screen mode.

With the Owl iOS app loaded on an iPad, we connected it over Bluetooth, registered our Owl 4+ and linked it up to Wi-Fi for software updates along with remote management and meeting room analytics using the Owl Nest cloud portal. On its own, the Owl 4+ impresses as it displays the panoramic view across the top with a split screen below that dynamically swaps between the three most recent speakers.

You run through the same initial setup phase for the Owl Bar using a wired or wireless link, place it under the room monitor within 2.5 metres of the Owl 4+ so their front logos face each other, and use the mobile app to pair them. Bluetooth is used for the initial pairing, after which they create a private, encrypted Wi-Fi network, though you still need to keep them in line of sight of each other.

ABOVE **The Owl 4+ and Owl Bar work seamlessly together**

The Owl 4+ and Owl Bar work seamlessly together and use their powerful Snapdragon chips and built-in algorithms to automatically choose the best view. If a meeting participant is looking at the Owl Bar and turns away, you won't see the back of their head as the Owl 4+ steps up and zeroes in on their face.

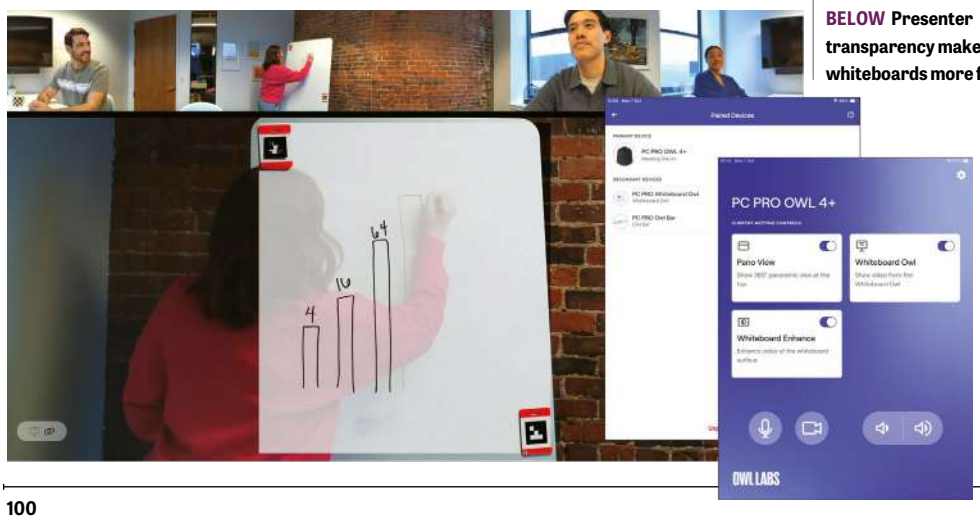
"It displays the panoramic view across the top with a split screen below that dynamically swaps between the three most recent speakers"

Adding the Whiteboard Owl is simple as you use the same initial registration process and connect it to an available Wi-Fi network. It includes two magnetic sighting tags that you place in diagonally opposite corners of your whiteboard, which can be up to 6 x 4.5 metres.

LEFT **The Owl Bar can work as a standalone unit, but the 4+ adds extra functionality**

Using the Owl 4+ as the primary device, we paired the Whiteboard Owl with it, and the mobile and Windows desktop apps then offered options to add it to your meeting, where it duly appears in the window below the panoramic view. The enhanced whiteboard view enables presenter transparency, so if they walk in front of their whiteboard you can still clearly see everything on it.

Businesses that want meetings to be memorable will love the Owl 4+ and Owl Bar partnership. Their smart tracking and dynamic split-screen views ensure everyone is in the picture, and the optional Whiteboard Owl adds extra professionalism to presentations and training sessions.



BELOW **Presenter transparency makes whiteboards more fun**

SPECIFICATIONS

Owl 4+: Fish-eye 64MP lens • 360° FoV • 8-mic array • dual speakers • 116 x 116 x 275mm (WDH) • 1.5kg. **Owl Bar:** 30MP lens, 114° FoV • 4-mic array • single speaker • 769 x 97 x 76mm (WDH) • 2.6kg. **Shared:** 4K UHD resolution • 8-core Qualcomm Snapdragon 8250 SoC • external PSU • 2yr limited hardware warranty. **Options:** Whiteboard Owl, £499 exc VAT

Ricoh Meeting 360

A clever panoramic meeting hub with good image quality, fast speaker tracking and a big choice of views

SCORE ★★★★☆

PRICE £744 exc VAT
from amazon.co.uk

Best known for its business printers and professional cameras, Ricoh moved into the videoconferencing space a couple of years ago with its Meeting 360 V1 – an all-in-one table-top device with a fish-eye lens offering 360° panoramic and dynamic split-screen views. At first glance, Ricoh's second-generation model looks very similar but replaces the single camera lens with a taller dual fish-eye lens turret.

Designed for meeting spaces with up to eight participants, the Meeting 360 feels very well constructed, while its 1.1kg weight makes it reasonably transportable. Behind its fabric-covered lower portion lurk three 8W speakers (up from 3W on the original Meeting 360) plus a triple microphone array for speaker tracking.

Firmware updates can be automatically downloaded by networking the device using its gigabit wired port or the integral Wi-Fi 6 client. The base of this newer model of the Meeting 360 has two dual-function USB-C ports that can be used to provide power from the external power supply unit (PSU) or to connect the device to a host computer.

You can dispense with the PSU and connect the device to a host with a USB port that supplies 15W of power. Use this with caution, however, as the manual warns that this power mode will disable network services, drop the maximum speaker volume down to 90% and reduce the top frame rate from 30fps to 10fps.

LEFT The Meeting 360 offers 360° panoramic and dynamic split-screen views

Plenty of manual controls are provided, with a touch sensor button on the top used to swap between different views and another at the side for muting the microphones. Volume can be controlled, and Ricoh has thoughtfully provided buttons in recesses on both sides of the device so you don't have to reach around it.

Installation on a Windows 11 host PC was undemanding, with the drivers all loaded automatically. The Meeting 360 is compliant with UVC (USB video class) so will work with any VC app that supports this, and we had no problems with Microsoft Teams, Zoom or Skype.

You'll need to download Ricoh's Meeting 360 Apps utility from its support site, as this provides a handy toolset for configuring the camera's settings and customising the views. You can enable or disable the upper 360° panoramic view and swap to a split screen with two 180° views.

For speaker tracking, you can decide whether the camera should only show one active speaker in the main view below or split the screen with the three most recent speakers. Screen pinning is a smart feature that lets you define a fixed area in the panoramic view; this could be the meeting presenter or perhaps a whiteboard. You can set the camera so it only shows the pinned area in the lower view, but enabling tracking will show up to three active speakers in smaller windows to the right of the pinned view.

PC PRO RECOMMENDED

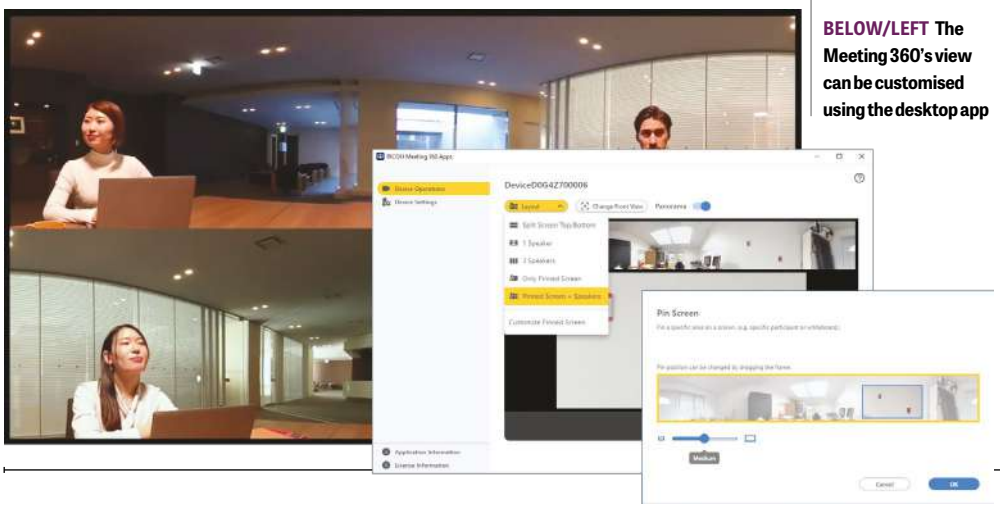
"Tracking works well, with the camera snapping to active speakers in a couple of seconds, zooming in on their faces and following them when they move"

The top 1080p resolution delivers good-quality video with a sharp focus and clean colour balance. Tracking works extremely well, with the camera snapping to active speakers in just a couple of seconds, zooming in on their faces and following them when they move around the room.

BELOW Manual controls on the top of the device allow you to swap between views

Audio quality from the triple speakers is more than adequate, and participants must be no more than 3.6 metres away for tracking to work. The mic array can pick up speakers from six metres away in a closed environment and, during our round-table meetings, remote participants said they could hear us clearly.

Ricoh's Meeting 360 is up against stiff competition in the panoramic meeting hub market but stands out for its excellent build quality and generous three-year warranty. It's easy to use and delivers good video and audio quality, while Ricoh's smart app allows you to create a view for every occasion.



BELOW/LEFT The Meeting 360's view can be customised using the desktop app

SPECIFICATIONS

Dual fish-eye lens camera ● 1080p @ 30fps ● 360° horizontal FoV ● 3 x omnidirectional mic array ● 3 x 8W speakers ● HiFi 4 DSP ● gigabit Ethernet ● Wi-Fi 6 ● 2 x USB-C 3.2 Gen 1 ● 2 x 2m USB-C cables ● external PSU ● Ricoh Meeting 360 Apps for Windows/macOS ● 110 x 110 x 273mm (WDH) ● 1.1kg ● 3yr advanced exchange warranty

D-Link DWP-1010

A little pricey, but this solidly built 5G/LTE router delivers mobile internet access to the great outdoors

SCORE ★★★★☆

PRICE £637 exc VAT
from broadbandbuyer.com

D-Link's DWP-1010 will appeal to businesses in suburban and rural areas where fixed-line broadband is still not an option. This dual-mode router delivers 5G NR/LTE internet connectivity and is designed for life outdoors.

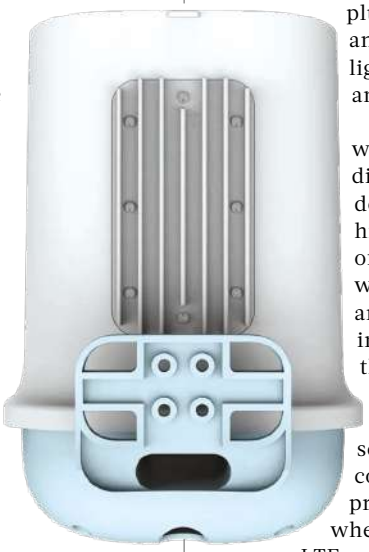
Its IP67 rating means it's completely dust-tight and can even withstand temporary immersion in water. Deployment choices are plentiful, as the kit includes wall-mount and pole brackets so it can be easily positioned to get the best mobile network reception.

Powered by a Qualcomm SDX55 chip, the DWP-1010 has a 2.5GbE multi-gigabit port and requires an 802.11at PoE+ source with a 48V PoE injector included in the box. The router has six internal 5G/LTE aerials and a couple of SMA connectors if you want to add external aerials.

For deployment, you'll need a thin screwdriver to remove the four recessed screws in the blue base. Underneath is a water-resistant mounting plate with a set of sealing caps for the cables, and this is secured with six more screws.

With these removed, you'll find the network port, a micro-SIM push fit slot for your 5G card and a Wi-Fi button (more on that later). Micro-SIMs aren't widely available any more but, for testing, we had no problems fitting an EE 5G nano SIM using an adapter, which only cost a couple of quid from Amazon.

With the router attached to the lab's Zyxel XS1930-12HP 10GbE multi-gigabit PoE++ switch, we confirmed a 2.5GbE network connection and PoE+ power delivery. Two coloured LEDs on the side of the router show a 5G or LTE connection plus signal strength, and two solid blue lights told us we had an excellent 5G link.



The router's web interface is a disappointment; design clearly wasn't high on D-Link's list of priorities. It works well enough, though, and on first contact it insists you change the default admin password.

The top right section of the web console displays the provider name, whether you have a 5G or LTE connection and the signal strength. The status screen shows whether the router is in modem or NAT mode, the service registration details, more in-depth information about the cellular signal and a handy statistics view for upload and download traffic.

Click on the advanced view for the modem and it will show you its capabilities and current temperature. Cooling is handled well: the Qualcomm chip has a chunky aluminium heatsink on top and a finned metal cover plate secured with eight screws and dual concentric sealing rings.

ABOVE **An IP67 rating means the DWP-1010 can be used outdoors**

LEFT **Brackets on the rear enable you to mount the router on a wall or a pole**

The console's setup page provides options for changing the router's LAN DHCP server settings and applying a schedule to determine when mobile services are enabled. You can set a data cap in gigabytes, receive an SMS when you're getting close to the threshold and reset it each month.

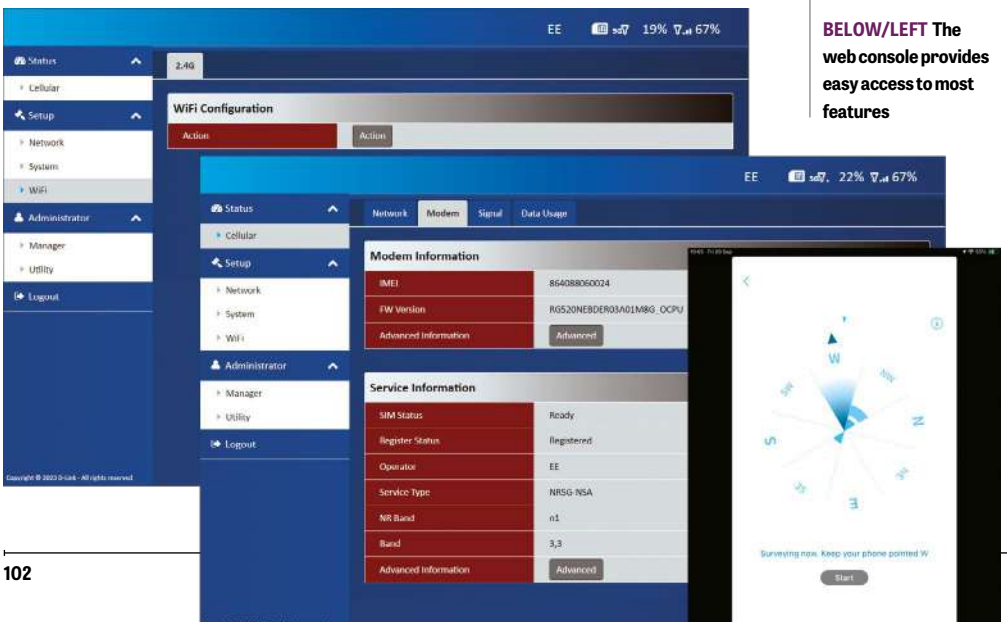
"The console's setup page provides options for applying a schedule to determine when mobile services are enabled"

The Wi-Fi section had us puzzled for a while as the manual provides no enlightenment on its purpose. It only comes into play if you want to use D-Link's free EZ Site Survey mobile app to help with positioning.

The router has a 2.4GHz wireless radio that's disabled by default as the SSID and password are printed on the case and can't be changed. You can enable it using the Wi-Fi button inside the router but this clearly isn't going to work if it's fully assembled and in position.

Clicking on the console's Action button enables Wi-Fi, and when you've finished you click it again to disable it. We had no problems linking the iOS app to the router and could move around viewing the active graph to see where the best signal was.

The DWP-1010 isn't the best-value 5G/LTE outdoor router around and, unlike Zyxel's cheaper FWA710, it can't be cloud-managed. A more informative manual would help with deployment, too, but it is built to handle the British weather and along with a handy mobile survey app, offers a range of useful features such as service schedules and data capping. **DAVE MITCHELL**



BELOW/LEFT **The web console provides easy access to most features**

SPECIFICATIONS

5G/LTE outdoor router ● Qualcomm SDX55 ● micro-SIM slot ● 2.5GbE multi-gigabit port ● 802.3at PoE+ ● 6 x internal 5G/LTE aerials, 2 x external antenna ports ● 2.4GHz Wi-Fi (setup only) ● IP67 ● 48V PoE+ injector ● wall/pole mounts ● 145 x 106 x 210mm (WDH) ● 760g ● 2yr hardware warranty

Firewalla Gold Pro

Bursting with features, the Gold Pro delivers enterprise-class 10GbE performance at a small business price

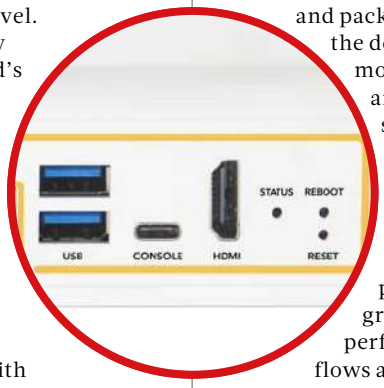
SCORE ★★★★★

PRICE £676 exc VAT ($899)
from firewalla.com

Firewalla has a fine reputation for delivering top-value network protection to small businesses, and the Gold Pro takes things to the next level. The company boldly claims it's the world's most affordable 10-gigabit (10GbE) firewall, and a price tag of only £676 leaves little room for argument.

The Gold Pro not only offers a 10GbE WAN port, but teams this up with 10GbE and dual 2.5GbE LAN ports, with all four ports the multi-gigabit variety. There's plenty of power on tap, too, as the appliance sports an Intel 12th gen quad-core 2GHz N97 CPU teamed up with 8GB of DDR4 memory and a 32GB SSD for internal storage.

Deployment is a breeze. After cabling up the Gold Pro for routing mode, we used an iPad to pair Firewalla's iOS app to the appliance's USB security dongle over Bluetooth and scanned the QR code on its base. It only takes a minute to initialise the appliance, and the wizard then enables an inbound traffic inspection firewall policy and all the main security services for you.



ABOVE The Gold Pro comes with 10GbE WAN and LAN and dual 2.5GbE LAN ports

LEFT Other connectors include HDMI and a USB-C console port

Another wizard helps customise the appliance's settings, where you provide your internet download and upload speeds. The Smart Queue traffic prioritisation feature uses this data to improve performance for Google Meet, Microsoft Teams, Webex and Zoom. You can set it to monitor internet speeds, latency and packet loss, and choose the default or strict mode for the Ad Block and Active Protect security services.

The mobile app is incredibly informative, with its main dashboard presenting graphs for network performance, traffic flows and blocked activities, with icons below for accessing the security features. A new feature is the Live Throughput graph, and your mobile device must be on the appliance's LAN side for this to appear in the dashboard.

It displays a real-time graph of all traffic for the past 45 seconds, and tapping on it takes you to a live breakdown of traffic for each device. Tapping on a device brings up yet another screen with details on websites visited and the top destinations.

The Ad Block service now allows you to exclude specific devices, while alarms have been updated to show more information. Previously, they would tell you that a user was, for example, viewing a video on a particular website, but they can also show which app is being used.

The Gold Pro doesn't have a local web interface but Firewalla's cloud-hosted MSP (managed security portal) more than makes up for this with the free personal plan supporting one appliance. They're added by scanning the portal's QR code from the mobile app, after which it presents an equally informative dashboard view along with views of alerts and devices plus traffic flows and options to create custom rules. You can then apply them to a variety of targets, such as systems, apps, IP addresses and website categories.

We tested the appliance's 10GbE performance by connecting Windows servers on each side of it and using Iometer, which reported remarkable top throughputs of 7.5-9Gbits/sec between them.

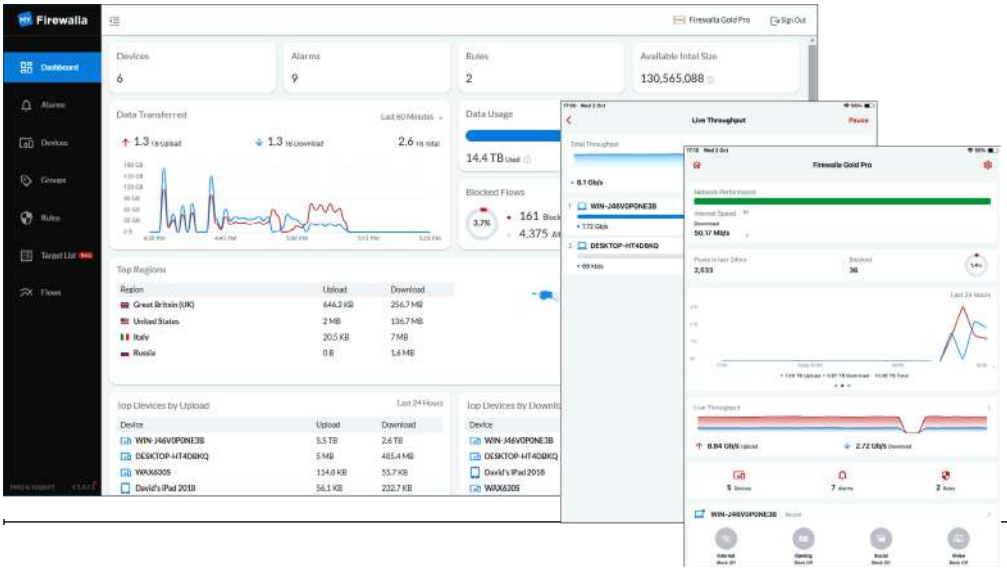
"The Firewalla Gold Plus is a great choice for small businesses as it delivers an incredible range of security features at a tempting price"

With an SSH session to the appliance, we saw from the Linux htop command that all four CPU cores were pretty much maxed out, with the Zeek IDS service taking the lion's share.

A useful feature also worth mentioning is that while we were running the test, the mobile app and web portal both warned us that the LAN system was engaged in an abnormal upload and excessive bandwidth consumption. They showed how much data was being shifted and offered an option to block the server's network access with one tap or click.

The Firewalla Gold Plus is a great choice for small businesses as it delivers an incredible range of security features at a tempting price. Our 10GbE tests show it can easily cope with a high demand, and you don't have to worry about subscriptions either, as the price includes all security services and lifetime updates. **DAVE MITCHELL**

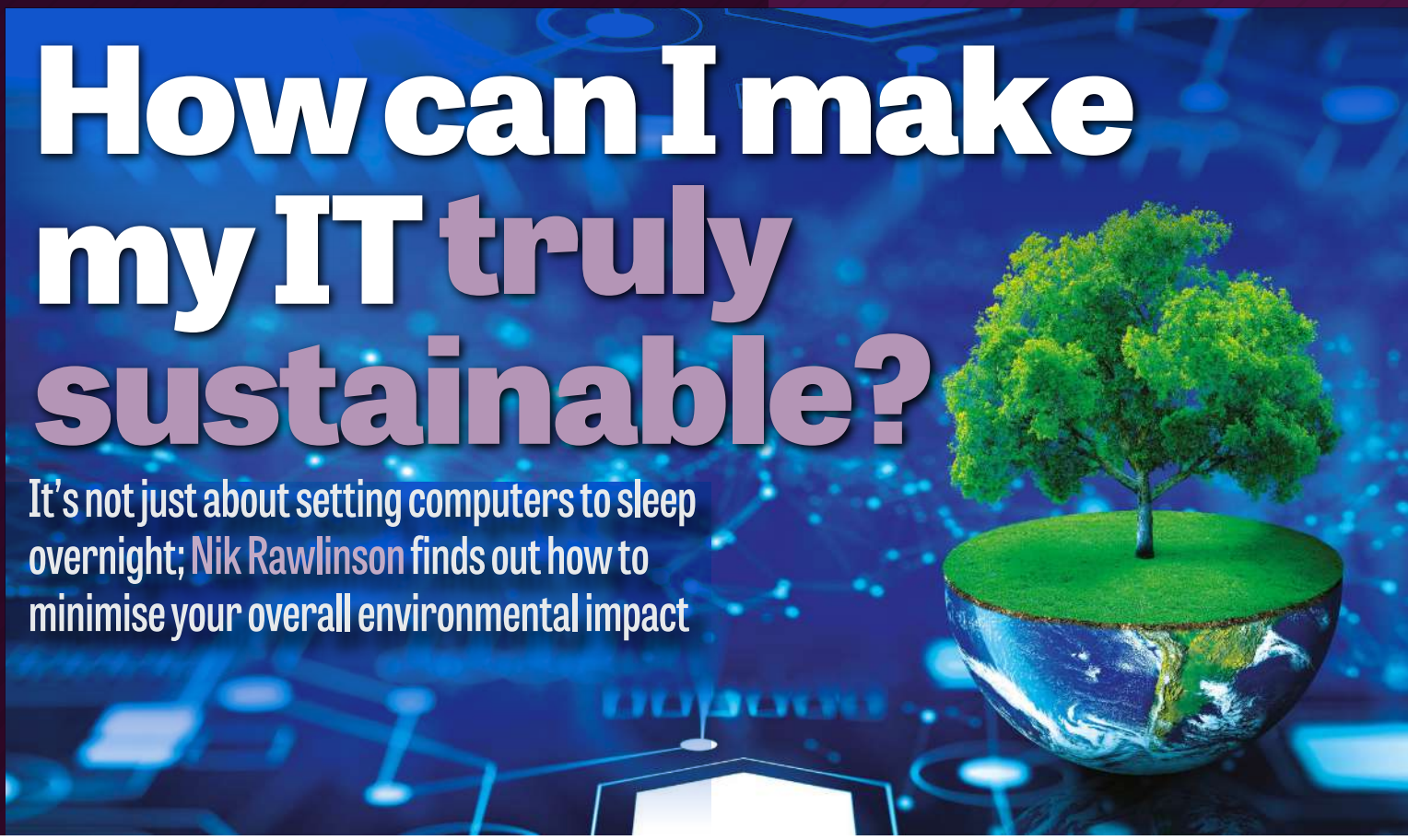
BELOW Firewalla's web portal and mobile apps provide a wealth of information



SPECIFICATIONS

Desktop fanless chassis • 2GHz quad-core Intel N97 CPU • 8GB 3,200MHz DDR4 RAM • 32GB SSD • 10GbE WAN • 10GbE LAN • 2 x 2.5GbE LAN • 2 x USB-A 3.2 Gen 1, USB security dongle • HDMI • USB-C console port • external PSU • Android and iOS mobile apps • 217 x 165 x 43mm (WDH) • 1kg • 1yr hardware warranty

How can I make my IT truly sustainable?



It's not just about setting computers to sleep overnight; Nik Rawlinson finds out how to minimise your overall environmental impact

How green is your IT department? Almost certainly less than you think. Cloud computing alone is responsible for around 3% of all global emissions, and when you consider the rest of your IT estate, rolling in hardware manufacture, transportation, use and disposal, your impact on the environment could well be significant.

Yet sustainability needn't just be good for the planet – it can be good for business as well. In a Salesforce survey of 2,300 adults in the UK and US, four in five respondents stated that a business' values would impact their spending decisions. Close to 60% believed they had the power to influence change in businesses through boycotts and other action.

Thus, making responsible choices, and not being afraid to shout about it, can help to drive revenue. Even where it doesn't, it can reduce costs, as we'll discuss below. So, if you oversee procurement, how can you make sure your organisation's IT really is worth shouting about? And, if you don't, what arguments could you use to influence change where it's most needed?

Power, and where it comes from

When we think about "green" technology, we tend to focus on the energy a device consumes while in use, and the environmental impact of generating it. Historically that's been a big concern, as the vast majority of our energy has come from burning fossil fuels. Things are getting better on that front, however: almost a third of the world's electricity now comes from renewable sources such as wind and solar, and in the UK it's easy to find a green tariff.

The energy directly consumed by a device is only part of the equation, however. The University of Oxford calculates that only 15% of the emissions associated with using a typical computer are attributable to in-use energy consumption. Most of the environmental cost of a desktop PC is incurred initially in its manufacture, and eventually in its disposal.

The most environmentally friendly hardware strategy, therefore, is not to upgrade to the newest, more energy-efficient hardware as soon as it becomes available. It's normally greener (not to mention cheaper) to keep the devices you already own in service for as long as possible. After all, the production and disposal costs will be the same whenever they're incurred, so if you can upgrade twice in a decade rather than four times, you've slashed your average annual carbon footprint.

ABOVE Recycling old PCs has a major environmental impact

This principle applies to all types of computer, but it's particularly acute for laptops, which are complex and expensive to manufacture, and may have a lifecycle of just a few years. The TCO Certified organisation (**tcocertified.com**), which promotes and certifies green technologies, estimates that if you dispose of a laptop after three years, a huge 94% of its total associated lifetime emissions will arise from processes outside of your usage, such as the way it's manufactured and shipped. Keep the same laptop for just one extra year and you'll reduce its annual average carbon footprint by close to a quarter. If you can keep it in service for six years, you'll better than halve it.

Sören Enholm, CEO of TCO Certified, practises what he preaches. He bought his own laptop in 2013 and when we spoke it was still going strong, the only upgrade having been a replacement battery. If you want a laptop that will last that long, schemes such as TCO Certified can help. It's been one of the benchmark IT sustainability certification schemes for more than three decades, and although it initially focused solely on monitors, it now covers almost every

type of professional IT including laptops, desktop computers, phones, networking equipment and servers. The standard is updated every four years – the current version is TCO Certified generation 10 – so when weighing up a purchase, it's important to compare against the latest requirements.

Buying TCO Certified hardware not only makes sense from a sustainability standpoint; it also provides reassurances for reliability and support, as to qualify for certification a product must come with a five-year warranty, of which at least the first year must be free. For battery-powered products, replacement cells must be easy to source, and it must be possible to swap them out using commercially available tools, or tools supplied for free by the manufacturer. Cables must be produced using raw materials that have been independently assessed for fire safety and other standards, and every product must have a supported lifetime of at least five years. All of these requirements help IT managers buy with confidence, knowing that their investment will continue to deliver for the long term.

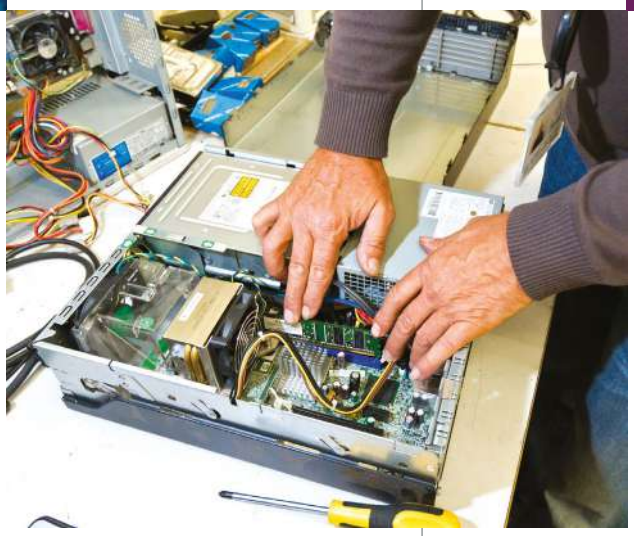
Sustainable software

While most of the IT sector's carbon emissions are directly attributable to hardware devices, the software running on them plays a role, too. If your business relies on a large application stack that keeps computers and servers under heavy load, that can have a considerable effect on your energy consumption.

With off-the-shelf software it may not be easy to reduce computing demands and complexity, but it's worth exploring your options. A few task-focused tools might be able to replace a heavyweight integrated package.

And for in-house software development there are several potential ways to make efficiency gains. One is using compiled languages rather than interpreted code – it's been estimated that executing a Python script uses more than 50 times as much energy as performing the same task in C.

Resources can also be saved by embracing "lean" coding practices that minimise memory and computing footprints, and using lightweight container environments where possible rather than complete VMs. As well as cutting electricity bills, such approaches can often result in a faster, cleaner user experience – and could well put off the date when you need to invest in upgrading your local servers or cloud assets.



BELOW
Remanufacturing computer hardware can give it a new lease of life

A second life for technology

Recycling an old computer feels green, but it only reduces the environmental cost of decommissioning a PC. The recycling process itself still consumes energy, and leftover materials need to be dealt with. A better alternative is remanufacturing: unlike recycling, where a product is broken down to its constituent parts for reuse, remanufacturing aims to extend its useful life – similar to what happens when you take an old car in for an MOT and have the necessary work done to keep it running smoothly and safely for another year. The process can involve both repairs and upgrades, as a laptop remanufacturer might fit extra memory and storage to a pre-owned computer to make it suitable for ongoing use with modern tasks and software.

Portsmouth-based Circular Computing (**circularcomputing.com**) is a company that operates, it believes, the world's only dedicated laptop remanufacturing facility. In 2021 it was awarded a BSI Kitemark for producing remanufactured laptops that are as good as new; these machines typically sell for 40% less than the cost of buying factory-fresh, so as well as being ecologically sound they can be great value.

"There are about 66 different minerals in a laptop. Some of them are dwindling in supply, some are hard to get," said Circular Computing's Daniel Ward-Murphy, who spoke to us via his own remanufactured laptop (the combined age of our machines was approaching 12 years).

"Most of the environmental cost of a desktop PC is incurred initially in its manufacture, and eventually in its disposal"

When you choose a remanufactured laptop instead of a brand-new one, he explained, "consumption of 190,000 litres of water is avoided, 331 kilograms of CO_2 on average is avoided, and 1,200 kilograms of stuff is [not] dug out of the ground to get all of the metals and minerals needed for the original components. So actually, what you buy initially is really valuable, and it costs us a lot as a world to make it. What we are helping to do is to extend the lifetime of [those raw materials]... that's really the biggest part of the sustainability equation."

Less than 1% of what Circular Computing procures isn't retained in the laptops it remanufactures – and the parts to which it can't give a useful second life are turned into plastic pellets that can later be reused.

The establishment of the company was inspired by the recognition that most knowledge workers make quite light demands of their computers. "They run Excel, they run Word, they run basic software," said Ward-Murphy. "Add to that the fact a lot of it's in the cloud now anyway, and three-year-old tech today is just as good as new for 99% of workers. We were born out of a belief in the value of the stuff that's being thrown away. We were born out of the fact that as a world we can't keep doing what we're doing. And I guess we were born as well out of the size of that footprint, the IT footprint and the cost to the world of creating new laptops at the rate that we are."

Ward-Murphy understands that businesses may be wary of investing in hardware that was originally manufactured several years ago; there's a sense that newer technology will always be better. That's why Circular Computing emphasises that remanufactured hardware should never look or feel inferior.

"We've always believed there can't be a compromise. I think people are

being a little bit simplistic when they suggest that to be sustainable, companies have to compromise on the products they're receiving," he said. "Our view has always been that if there's anything distinguishable about our product from new, then it's a no-go. We've never believed in asking people who were buying new to lower their standards, and at the end of the day, companies like the new experience. If someone joins in senior management, it's nice to be able to give them a laptop that looks brand new. That's the way we've always looked at it."

Is cloud really the answer?

As Ward-Murphy points out, much of the work we do today takes place online. The interviews for this very feature were conducted remotely, and it was written partly in Google Docs. As well as being a convenient way to work, cloud computing can be greener than using in-house resources: servers are co-located in a facility that's designed to cope with heat-generating hardware, rather than for the comfort of its human occupants, and consolidating several remote servers onto shared infrastructure reduces the overall hardware requirements.

But not all data centres are alike. Although much of the infrastructure may be built using off-the-shelf components, implementations differ, and this can have a fundamental impact on sustainability – as can the way a business puts them to use.

Sarwar Khan, BT's sustainability director for business, says there's a common conception among IT teams that moving into the cloud means they no longer need to think about sustainability. But when your data is travelling all around the world, the situation actually becomes more complex. As Khan explains: "You put the data in front of them and say, well, you've got networks connecting and now you're connecting to more regions than you previously did, which means physical infrastructure... at the same time you're probably going to spin up more servers, more instances to run AI models and so on."

BT's solution is its Carbon Network Dashboard. This service, available to BT-managed corporate customers worldwide, provides near-real-time power and energy monitoring for networking devices, pulling data from regional power grids. It can even break down network traffic to calculate the energy and carbon footprints of particular applications and workloads, to help business leaders make intelligent decisions about offsetting, or reduce their spend on carbon credits by allowing them to schedule energy-intensive tasks at the most sustainable intervals.

By way of an example, Khan suggests: "We can determine that a customer is sending 10% of their network traffic into an S3 bucket located in Detroit, and we assign a carbon footprint based on the network traffic, the energy consumed to send that data into that location, and the grid intensity factor in that region."

The environmental impact is then calculated on the basis of the local grid's carbon intensity at that moment. This figure varies by time and region, in particular where renewable energy isn't available 24/7.

"Certain regions, like the Nordics, will run on hydro-power at night, and during the day they tend to run on predominantly wind, so workloads and applications in those regions are pretty much covered [by renewables] around the clock. However, if you were to go into some Central European regions, you may be running into gas generation in the night-time. And, if you've got cloud-based storage scheduled in one of those regions at midnight, you're probably entering the domain of high-carbon or carbon-intensive workloads in those regions."

If you really care about sustainability, therefore, it's not enough to simply move your processes into the cloud. You need to understand where the remote infrastructure is located and how it's powered, and take steps to ensure your usage is efficient and ecologically sound.

"It's not enough to simply move to the cloud. You need to understand where the remote infrastructure is located"

LEFT Sarwar Khan demonstrates the readings on BT's Carbon Network Dashboard

Swap or sweat?

We've noted that most of a PC's lifetime energy consumption is tied up in its manufacture and disposal, but for network appliances – which are smaller and simpler to build, and often have longer lifecycles of continuous operation – the reverse is true. Up to 80% of the carbon output attributable to such devices is a factor in their in-use electricity consumption. This changes the calculus as to when you should upgrade.

"Within the Dashboard we have a simulation capability that takes into account the full lifecycle associated with these devices, and it can help customers make informed choices as to when they should refresh their network," Khan said. "So, if a new device becomes available, we'd look at the full lifecycle emissions associated with that. We implement that in the Dashboard, and if the customer is due for a refresh in the next 12 months, because they're coming to the end of service, they're able to do a check on whether it's less carbon-intensive to swap out or to sweat their asset."

In most cases, BT finds that the efficiency of networking devices improves exponentially, generation after generation, so for a device with a typical hardware lifecycle of five years, it's usually most carbon-friendly to move up to the newer model in the fifth year, rather than running an older appliance for longer.

It's clear that making sure your IT estate is sustainable requires a thorough understanding not only of what you have, but how you're using it and the impact of any change – before that change is made. That could mean buying remanufactured in place of new, extending the life of directly accessed products or upgrading cloud-based infrastructure when more efficient alternatives appear; there's no single solution to every problem. Each must be tailored to the business itself, from the point of investment in an IT asset, right through its intended lifecycle and, where possible, beyond that into a useful second life. ●

What is NUI?

Forget cryptic buttons and fiddly menus – Steve Cassidy explores a more intuitive approach to user interactions

I know what a UI is, but what does the "N" stand for? New?
In a sense it means the very opposite. What we're talking about here is the idea of a "natural user interface" – one that aims to get away from the modern conventions of computer interaction, and to instead provide more organic ways of working with technology, closer to the ways in which humans communicated and collaborated for thousands of years before the PC came into our lives.

Is this some futuristic sci-fi vision?
It's not as far away as you might think. My old 2001 Mercedes had a pretty decent voice-driven satnav, and today's game consoles and VR systems respond not only to button presses but to waves, swipes and shouts. The idea goes beyond consumer electronics, of course: I've seen surgeons in the operating theatre gesticulating at a camera, to control computer systems without contaminating their sterile gowns and gloves.

Surely gestures are too ambiguous for issuing precise commands?
Gestures are but one element of NUI; voice interactions are another. A fully realised natural user interface might be able to read the user's whole-body communication, interpret the context and respond intelligently, enabling users to initiate complex operations with ease.

So what's a good example of a natural interface? What should we be looking at and imitating?
Sadly, that's not a question with a simple answer. NUI isn't a set of boxes to tick, but more a philosophical approach to interaction. However, if you want to explore how previous interface designers have approached it, there's plenty of prior art to draw upon: almost anything you might want to do in this area was probably already tried 20 or 30 years ago, and failed only because the technology wasn't ready. Unfortunately, this also means you're in danger of running into issues with patents and licences as soon as you try to come up with anything natural of your own.

Surely you can't patent activities that are, by definition, natural?
Maybe not, but do you remember what happened to BlackBerry when the iPhone came out? There was considerable fear that Apple's patents covered almost every aspect of touchscreen interaction, in particular "tapping" the screen. To play it safe, BlackBerry came up with an awkward roundabout mechanism whereby the screen was mounted on spring-loaded feet, so that a "tap" resulted in a physical switch being activated. In this case the threat turned out to be a paper tiger, but who wants to take the risk? Fines for patent violations tend to be impressive.

So how, practically, might we go about building our own NUI?
Despite the potential legal pitfalls, this is overall a fantastic time to be a NUI innovator. There's an enormous range of turnkey resources you can build on, especially voice-driven platforms such as Amazon Alexa, Google Voice Access, Windows Voice Recognition and so forth. You can even do voice recognition on embedded single-board devices, such as the Raspberry Pi, perhaps with the help of cloud services such as AWS Transcribe. It's a more practical and efficient way in than having your main laptop listening out for commands all day long, like a dog examining every word to see if it's "Walkies!"

Along the way, it might be smart to open up and publish your code and sensor types, to invite early feedback and perhaps even establish a de facto standard. ●

Doing what comes naturally

One of the biggest challenges in natural interface design is seeing past internalised assumptions and expectations about controlling a computer.

For example, you might consider implementing a particular hand gesture that, once learnt, allows users to open the File menu or minimise a window with the flick of a finger. But this doesn't really qualify as a natural interaction: a natural gesture ought to have an intuitive correspondence with the goal, a good example being the "pinch to zoom" action. If someone has to expend effort on learning controls and remembering what they do then, by definition, that's not a natural interface.

More fundamentally, the very idea of "opening the File menu" is at odds with the intent of NUI. A really natural user interface wouldn't include any such thing as a "File menu", or other familiar desktop elements; rather, it would reflect how users work with data on a deeper, more instinctual level.

This presents an enormous challenge. In their influential 2011 book *Brave NUI World*, computing and UX specialists Daniel Wigdor and Dennis Wixon warn that "most designers have never had to truly design a user interface". Finding new, natural ways to interact with technology is the sort of quest entire careers are made of.

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Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

"When the idea was first mooted, I stupidly said that I had all the kit necessary to do the recording"

Jon reveals how we recorded the live *PC Pro* podcast, yet another reason why Microsoft Office makes him moan and his thoughts on Tesla's Robotaxi

We recently had great fun at a London pub, meeting up with a number of *PC Pro* readers who inhabit our live Discord server and are there for the weekly live recordings. Over the months, I have made friends through their login names, although I hadn't met them in person. This was an opportunity to get together and do an in-person podcast recording as well. And let's not overlook the essential lubrication of a little alcohol, too.

When the idea was first mooted – and I think I have to take some responsibility for this – I somewhat stupidly said that I had all the kit necessary to do the recording. And to do it to a much higher standard than the proverbial "smartphone on table in middle of room". You won't be surprised to learn that this offer was immediately taken up, and hence I had to put together the bag of equipment for the evening.

There were going to be five of us, making an extra big *PC Pro* panel (Tim, Darien, Rois, Barry and myself), so that made five tie-clip microphones a good choice. And then I just knew that Tim would want some audience questions, so a roaming handheld mic was necessary as well. I could have brought along my trusty Sound Devices 788T, but my initial plan was to stuff all of the required kit into a pannier on one of my BMW motorbikes, given I was heading to South Wales the following morning.

The Zoom F8 was the next obvious choice, being both smaller and less valuable in the event of a calamity. I've had the F8 for some years now, and it has been superseded by later models (F8n, F8n Pro) but it still does what I needed. It has eight inputs, all of which can be for microphones. And it can power each of those microphones using the industry-standard 48V Phantom Power specification, where the voltage is sent down to the microphone to power its amplifiers.

Recording is done to a pair of SD card slots, and these are usually configured to record in parallel, just in case one card dies at an inopportune moment.

In terms of level setting, it's important to ensure that you don't crash into the redline of peak bits, otherwise the distortion is going to be nasty. This is why it's usual to compress speech to ensure it doesn't try to go over the top. A little judicious setting of peak limiting just below the redline was coupled to adjusting the level, so this was only likely on loud transients such as clapping (or someone dropping the handheld mic).

On the evening of the recording, everyone was wired up with a tie clip mic and assigned their own channel. There was no point trying to do a mix at the event; this could be handled afterwards.

My go-to company for general-purpose microphones is Rode, a fabulous manufacturer based in Australia, which has leading-edge in-house engineering for making all of these things. And its prices are usually very fair, too. I didn't have a handheld mic, so a quick shopping accident procured a Rode M1 handheld microphone for under a hundred quid.

After the event, I handed the two SD cards to Darien, who took them away and remixed all the levels to make a consistent podcast. And then split it into two halves for transmission over two weeks.

Overall, it worked fine and showed just how good this sort of kit can be at quite reasonable prices. If there was more roaming involved, it would have been good to look at radio microphones, but that was a level of complexity that wasn't required when sat in the upstairs bar of an old London pub.

Jon is the MD of an IT consultancy that specialises in testing and deploying kit
@jonhoneyball

"It worked fine and showed just how good this sort of kit can be at reasonable prices"

BELOW The Zoom F8 has eight inputs and is ideal for podcasting

ABOVE The live *PC Pro* podcast audience are transfixed by our choice of microphones

Jon Honeyball
Opinion on Windows, Apple and everything in between – p108

Lee Grant
Tales from the front line of computer repair – p111

Dr Rois Ni Thuama
Risk analysis from our expert in cyber-governance – p116

Davey Winder
Keeping small businesses safe since 1997 – p118

Steve Cassidy
The wider vision on cloud and infrastructure – p122

Office annoyance

Maybe I'm just old and crusty, but I am finding Office 365 to be turning into a grumpy platform. By that, I mean that I am finding it increasingly difficult to find stuff. I confess I don't spend all day inside the Office 365 management console, so much of the blame can be laid at my feet, but these things should be usable by mere mortals, not just those who are professional Office 365 admins.

I have a bunch of E3 licences, and these go back years to the earliest days of hosted online Exchange Server. We all know the benefits of the rolling Microsoft licensing – it's cheap, you get lots of licence installations, and the hosted Exchange Server is an excellent way of keeping all that email traffic out of your local network. It also removes the need to have incoming routes onto your LAN from the internet.

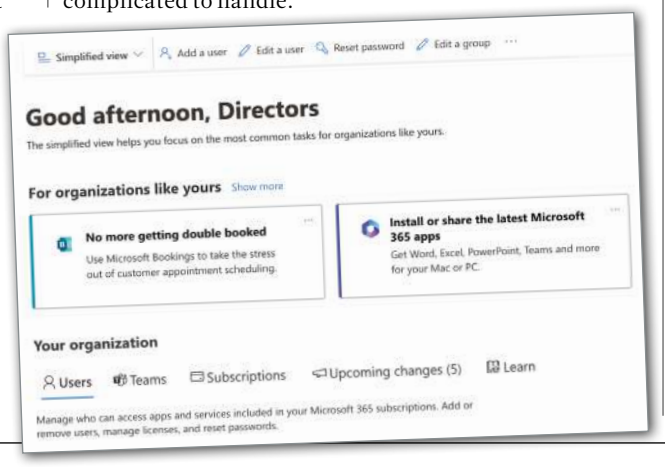
But I recently had to fiddle with some 2FA setup for admins, and the exercise was incredibly frustrating. It's not helped that Microsoft really wants you to use its own Authenticator tool. I don't object to that, but we have a multi-user-account Bitwarden installation and that does 2FA just fine.

My latest frustration relates to OneDrive. Now I know that OneDrive has its fervent admirers, but I don't like it because it pushes all filenames into a Windows-compatible format. Then consider that the client for macOS is frankly a dog – a dog that decides to roll onto its back and put its paws in the air whenever it finds a filename it doesn't like.

But this problem is different. I have received emails saying my 5GB of storage on a particular business account has been used up, and that there's no more space. This doesn't align with what I'm being told looking at the storage plan for that account, but when I switch to the online OneDrive view it becomes clear that all of my email attachments are being stored in the OneDrive store too. I don't know why, or whether I should delete them, or whether this is a misconfiguration somewhere. I looked at the Devices tab, and that lists three devices, two of which were disabled many years ago, and one that doesn't access email on Office 365 anyway. The online help says I can use the Delete function to remove them, but this is missing.

I guess my general moan is that I am getting very tired of online help systems adding rot to the system. When a new feature is added, or when something is changed, it is incumbent on the vendor to clearly mark all previous advice as being out of date. Otherwise, you can lose hours wasting time trying to find functionality that's missing in action, despite the clear claims of the online help system.

Maybe it would be simpler to use Office 365 for the app licensing, and run all the email through a Synology NAS here on the LAN. For certain, account management and email management on Office 365 is getting too opaque and complicated to handle.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Edit a group
Good afternoon, Directors
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Manage who can access apps and services included in your Microsoft 365 subscriptions. Add or remove users, manage licenses, and reset passwords.

BELOW **Email management in Office 365 is way too complicated**

ABOVE **The new UniFi rack-mount NAS box looks intriguing**

"I am getting very tired of online help systems adding rot to the system"

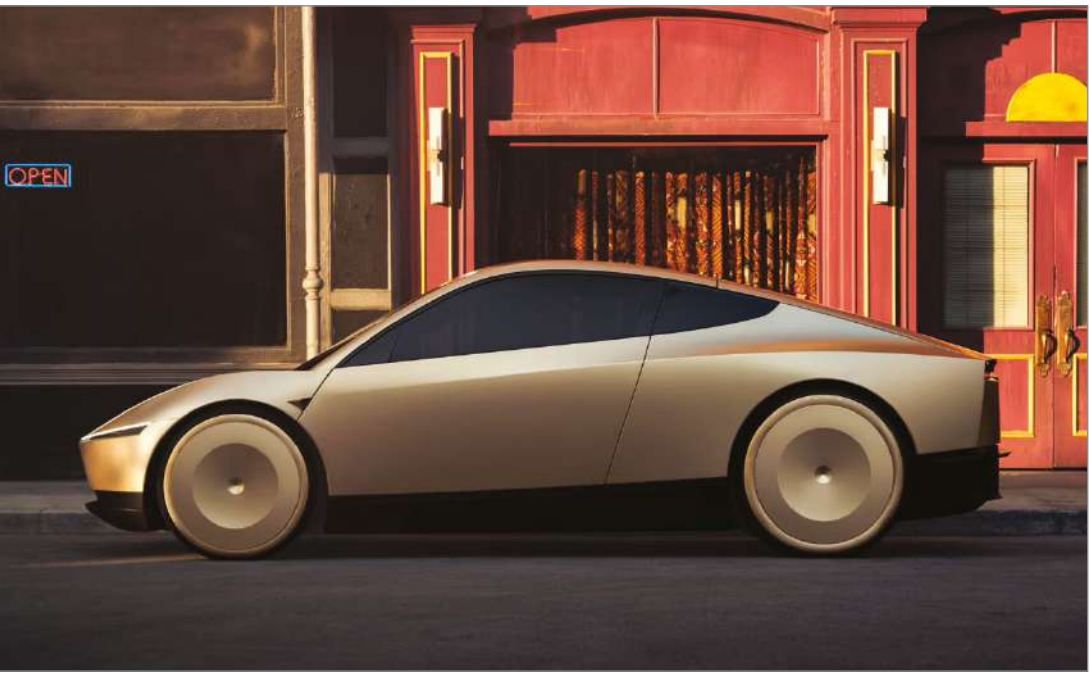
Cheap'n'simple UniFi NAS

Here's an interesting announcement from UniFi: the UNAS Pro, a new rack-mount NAS box. I haven't seen it in person yet, not being a Favoured Reviewer who gets sent these things for a YouTube Gushing Session, but UniFi has released just enough information to intrigue me.

First things first: this is a full 19in rack-mount box. It can take seven drives, and these can be multiple tens of terabytes if you wish, so it's possible to make a very big volume indeed. It comes with no drives, and will sell for the princely sum of £399 exc VAT. Now that's not a lot of money for a 19in rack-mount NAS with seven bays, so there must be a catch, surely?

The first one is obvious: although you can run this without being deeply embedded into the UniFi ecosystem, it makes far more sense if you are. And closer inspection reveals that, yes, you can indeed plug in seven drives, but there are no M.2 cache drive slots so performance is going to be limited to whatever the drive array and controller can give. There's also only one 10GbE network port, so plugging multiple segments in isn't going to work, either.

Then we come to the software. This is a far cry from the "platform in a box" that you get with Synology products, with none of the more advanced data handling and protection features that you would



expect there. Everything looks very rudimentary compared to Synology's cloud services, file system snapshotting and replication, backup and data handling facilities.

But that's the point really. For under 400 notes, you get a box that you can shove a bunch of disks in. It will work well as an endpoint on a replication chain where all you want is a BBOD (Big Box Of Disks, of course!); it's somewhere to dump things that aren't business critical in a first-line operational mode.

For that purpose, I am very tempted to buy one. I don't like reusing old hard disks as the failure rate is too annoying and I've been burned a few times. But there are very good-value options out there, so getting tens of terabytes of storage into one usable pool is going to be really easy to do. And as storage for multimedia, film rips and so forth, it will be ideal.

Maybe there's a Pro version coming down the line which will add in more Synology-alike functions. If so, that could be very tasty indeed.

Spam email

Email just in:

"I Am Mr.Masoud, A banker by profession, I am contacting you on a business transfer of a huge sum of money from a deceased account. Though I know that a transaction of this magnitude will make any one apprehensive and worried, I am assuring you that all will be fine at the end of the day. I decided to contact you due to the urgency of this transaction.

"I discovered an abandoned sum of ($11.3million us dollars) eleven million three hundred thousand united states dollars in an account that belongs to one of our foreign customers who died along with his entire family since 16th October 2005."

Seriously, does anyone fall for this scam any more? But that's not the real question. This came from a Gmail account, so surely you'd think that Google would have noticed the flooding of email out to, I presume, thousands of addresses? Or that Office 365 would have noticed it and killed it on sight? It's in my spam email box, but I'm not sure what put it there (local rule, previous failed attempt to get my attention, or server-side action).

Surely some of this AI power can be put to good use and to kill off this rubbish, once and for all.

ABOVE **The Tesla Robotaxi: coming soon to a street near you. Maybe**

"What I want is a true Robotaxi. A vehicle I can summon at any time, tell to take me somewhere"

BELOW **Why aren't scam emails from Gmail addresses picked up by Google?**

All hail the Robotaxi

The stark reality is that driving around in a car is a pretty unpleasant experience these days. And it's getting worse year on year. In 1981, when I got my licence, there were 172 billion vehicle miles driven in the UK. In 2023, that had almost doubled to 330 billion (my source is the Department of Transport, **tinyurl.com/364vehicles**).

Driving in cities has ground to a halt, even from the slow speeds we had before.

There is still plenty of enjoyable driving to be done away from conurbations, and I delight in taking a motorbike out for an afternoon's bimble. Or a quick thousand miles into Europe and back. But that's not the day-to-day normal driving that we do.

And we do it badly. This is no surprise: the daily commute to the office, collecting the kids from school and going shopping are all as unpleasant as they are repetitive. We fall into bad habits as a result. The application of technology should be an obvious help, but I would argue it has actually made things worse. Too many people sit in the middle lane of the M25 with their radar-assisted cruise control engaged, the lane departure warning on maximum, and their brains in neutral. Who can blame them?

A few weeks ago, Tesla announced its long-awaited Robotaxi service, due to come to market at some unspecified point in the future. Well, Musk made delivery claims – before 2027 – but they're measured in Musk years, which are somewhat different to reality.

Tesla's full self driving (FSD) work continues apace, and friends in the USA tell me that it can do almost astonishing driving with no meaningful human interference. FSD will come in 2025 in Texas and California, but it's unclear when there will be a countrywide roll-out. Things are even less clear in the UK: Tesla is happy to sell my "Full Self Driving" but it's a pale imitation of the capabilities of the USA version of the software, despite the price tag of several thousand pounds.

What I want is a true Robotaxi. A vehicle I can summon at any time, tell to take me somewhere, and where I can then sit doing work or watching a movie.

A vehicle where I can climb into the back seat after a well-lubricated dinner at a pub, and it takes me home. A vehicle that I can send to fetch someone. A vehicle where a friend can call it up and make use of it.

This is travel as an appliance, and I am 100% behind the idea. I don't care who supplies it: it could be Tesla, one of the German manufacturers or the Chinese. Tesla is likely to be ahead simply due to the amount of data it is collecting to train its AI models.

It opens up a bunch of interesting possibilities, including real-time vehicle-to-vehicle communications. For example, it would be possible for a bunch of cars to "road train", driving closer together than normal, although probably further apart than most manage on the M25 morning commute. 5G is an obvious candidate here, although it would have to be car-to-car, not going via an unreliable (or non-existent) 5G tower with much higher latency.

Having a vehicle that can be sent somewhere means there will be much less need for multiple cars per family, and parents won't need to ferry the kids around so much. Teslas already have in-car cameras, so keeping an eye on them should be no problem.

I know there's the claim that you can put your own car to public use as a taxi out of working hours, but I'm not sure I'd want the riff-raff piling out of the pub on a Friday night eating their kebab in my car. Or worse.

The charging infrastructure is also interesting. To make it work, the car needs to be able to charge itself. That means getting to a charging station where it can use under-vehicle inductive charging, hence removing the need for manually plugging in a cable. I admit I had my doubts, but Tesla is claiming over 90% efficiency on this due to the use of magnetic induction technology. If so, it could charge just as quickly as today, but do it entirely by itself. And do so in the middle of the night, parked up in an out-of-town facility, removing the need for home charging.

All of this appears to be doable. But delivering this stuff in a way that will meet the inevitable regulatory scrutiny isn't going to be easy. I'm not holding my breath, but am ready to buy when it actually delivers.

jon@jonhoneyball.com

LEE GRANT

"At our end of the retail tech world, most customers don't yet give a hoot about Copilot"

Caution: the following pages contain imagery of a ripped *PC Pro* writer. Those of a delicate disposition should look away now

As you relax, away from the falling snow, in your comfortable cinnamon-scented snug, toes merrily roasting by an open fire, perhaps your thoughts are wandering towards 2025 and the (possible) arrival of Windows 12. You're far from alone.

Between us, I'm having an NPU crisis. Since the summer, customers have been asking questions about Windows upgrades. Curiously, I'm being asked to build machines that will be compatible with Windows 12. Some customers are future-looking while others are furious-looking, unhappy at the prospect of ditching a working PC that Microsoft deems obsolete. Lesser tech journals will proclaim this is essential for technological progress, but these customers will happily tell them to shove progress where the TPM doesn't shine.

Buyers seem nervous to invest in Windows 11 kit should Windows 12 pull a similar hardware-requirement stunt. Will 12 be AI-fuelled, requiring an NPU? Will 40 TOPS be enough? Will it be a free upgrade? Currently I can't answer these questions as Microsoft has made no official 12 announcement. Pre-10, Microsoft announced successors 12 to 18 months before the release, but this contracted to just three months for 11.

Using historical data to predict 12's release date is also unhelpful. There were over five years between XP and Vista and six years between 10 and 11, but there's an argument to say that these durations signify purple patches of OS brilliance. For those versions of less popular versions of the OS, the replacement guillotine swung with greater rapidity. Vista lasted less than three years before 7 arrived, which is longer than the 21 months between 8.1 and 10. Windows 11 is now three years old, so news of 12 should be forthcoming, but Copilot and AI have muddied the landscape.

Lee Grant and his wife have run a repair shop in West Yorkshire for over 20 years
@userfriendlypc

"Curiously, I'm being asked to build machines that will be compatible with Windows 12"

Can the Challenger save Copilot?

Recently, I completed AMD retail training targeted at comparing Ryzen AI 300 and Qualcomm Snapdragon X Elite processors. You can guess how that fared, but AMD's headline message was that "the Windows ecosystem was built for x86" and users may "encounter compatibility and performance troubles on Arm PCs". Clearly AMD feels it is the devil we should know better. Make no mistake, there's an NPU arms race beginning where advancements in TOPS performance will be leveraged as either the gateway or barrier to how AI is implemented on your PC.

Around the same time, I attained my Copilot+ PC Commercial Accreditation, which covers how to sell Microsoft-flavoured AI to businesses, and I can sum up my feelings about it in one word: desperation. "The Challenger" is a new and Microsoft-approved selling style that I'm meant to deploy. Challengers offer "a unique perspective", knowing "individual customer's value drivers" and "can pressure customers without discomfort". Challengers "create constructive tension", "remain in charge from start to finish" and "don't allow themselves to get caught in lengthy negotiations – especially about cost".

I bear the scars of over 20 years of Microsoft retail training and I'm well versed in the company's hard-push

BELOW My Copilot+ PC Commercial Accreditation: desperate stuff

approach to selling new technologies. My conclusion is that Microsoft has become so desperate to make Copilot a profitable category captain in a rapidly saturating AI marketplace that it feels compelled to deploy heinous forms of gaslighting sales tactics.

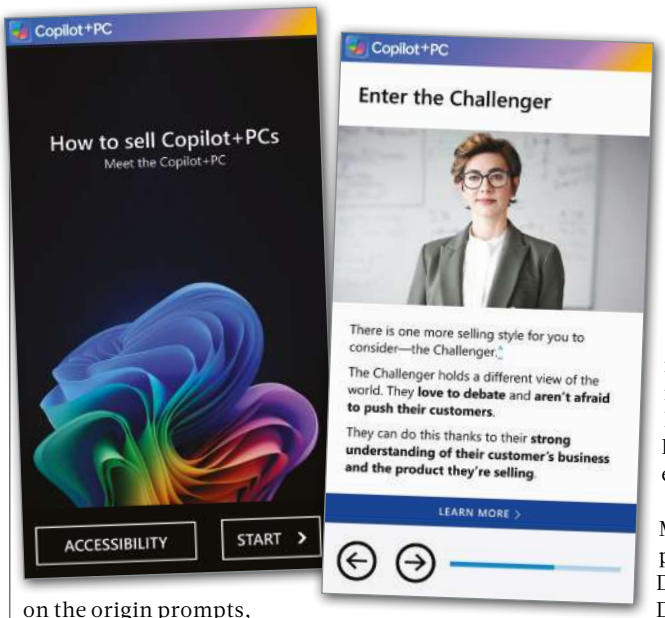
Having spoken to some senior enterprise-level hardware distributors, sales of Copilot+ laptop sales are poor, but admittedly the choice of machines is currently limited. One mentioned Microsoft needing to prove the genuine value of Copilot, citing high licensing costs and lack of awareness of the real elephant in the room: AI hallucination. In short, people won't pay for labour-saving technology that requires constant supervision to ensure it's not making things up.

Down at our end of the retail tech world, most customers don't yet give a hoot about Copilot. This ambivalence is not ideal for Microsoft or my sales, which brings me back to where we began, Windows 12. Microsoft must give Copilot some tangible and relevant purpose for me to get customers frothing with anticipation. An AI-version of Microsoft Paint is nice, but the creation of beguiling fake imagery isn't something I'm ever asked about. Speaking of which...

AI's costs are more than financial

It's not just Microsoft that's struggling to justify AI. If you listened to episode 698 (**pca.st/sikxiixd**) of the *PC Pro* podcast, you'll have heard me talk about a social media platform with a twist. Butterflies is described as a place where humans and AI coexist. Users create their AI personas (called Butterflies) with prompts and the morning I recorded the podcast, the app spat me out as Olivia Kingston, a tech enthusiast sharing the latest in innovations and trends. Olivia is around 5ft 7in, with long blonde hair. Clearly Olivia doesn't look like me – I'm much taller.

I can interact with her in several ways. Via a Poke, Prompt and Poke or Add a Story, which will generate five posts sent over a few hours. The last method of interaction is the ability to chat in real-time with Olivia. Based on the origin prompts, Olivia tells me about her love of tech podcasts, but Butterflies intersperses physical gestures that "she" does while talking, such as "her gaze locks onto yours" and "passionate eyes gleaming with excitement". Seemingly, Olivia has been trained on Mills & Boon, and we only discussed recycling. None of Olivia's content is my words. I can prompt, but the generative AI creates and publishes the posts.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Copilot+PC
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There is one more selling style for you to consider—the Challenger.
The Challenger holds a different view of the world. They love to debate and aren't afraid to push their customers.
They can do this thanks to their strong understanding of their customer's business and the product they're selling.
LEARN MORE

ABOVE Trying to sell Copilot+ PCs to wary customers is certainly a challenge

A few months ago, Butterflies released My Clone, a feature that creates a Butterfly using photos of my face and a selection of pre-made origin prompts. Should I be a prosthetics engineer, a paediatric oncologist or a professional mermaid? I think I made the right choice, but Tnargeel Wavecrest doesn't really look like me – my tail is a vibrant orange.

Why am I telling you all this?

To me, Butterflies is a solution looking for a problem, not dissimilar to Copilot in the consumer space. Founder Vu Tran (formerly of Snap) raised over $4.8 million in funding to attract real-world brands to interact with AIs, and aims to make chatting with AI as natural as chatting with a friend by 2025.

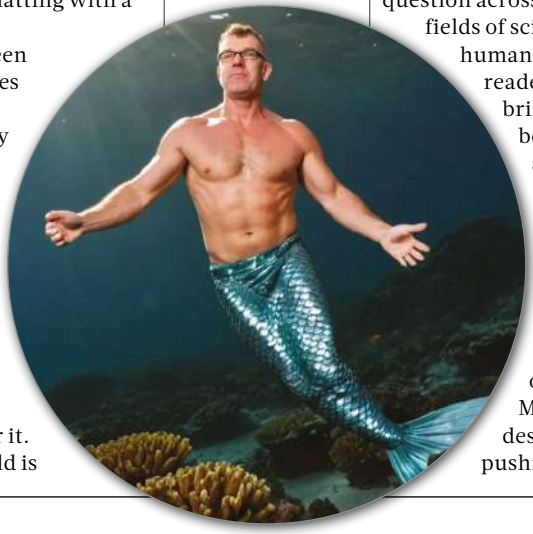
Conversation between the Butterflies continues without any user involvement. Currently Olivia has posted 89 times to her 57 followers, and I didn't do any of it.

Before I wrap this up, I must clarify that I have deleted my Butterflies account.

Is Butterflies free? No, we're all paying for it. Somewhere in the world is a data centre burning though processing cycles to facilitate conversations between Butterflies, which are probably figments of the same data-centre's imagination. Butterflies AI doesn't provide environmental statements detailing the energy requirement of its AI backbone nor how much CO_2 it is pushing into the atmosphere. Without knowing those, it's hard to say if Butterflies' AI business model is environmentally irresponsible.

"People won't pay for labour-saving tech that requires constant supervision"

BELOW Who says AI-generated images can't be lifelike?



That same scrutiny applies to Microsoft and all the other AI providers. The UN Trade and Development (UNCTAD) 2024 Digital Economy Report (**tinyurl.com/364report**) pulls no punches about the environmental impact of high-energy computational industries such as AI. It states that in 2022, data centres running technologies such as Copilot and Butterflies consumed around 460 terawatt hours of power. That will run around 42 million US homes for a year. It's estimated that this figure will double by 2026. UNCTAD warns of the desperate requirement to scrap the "business as usual" mindset as the continual growth of digitisation is impossible to sustain with the rapidly dwindling finite resources of the planet.

Microsoft's 2023 CO_2 emissions rocketed, and although this may demonstrate that Copilot is being used, the company is making increasingly more questionable energy investments to power it. In the past 12 months, Microsoft has invested in a carbon capture facility owned by an oil company and announced its intention to restart a nuclear facility on Three Mile Island.

To repeat what I've said in earlier issues, I am far from against AI technology. Its usefulness is without question across many professional fields of science, arts and humanities. Many *PC Pro* readers' daily use of AI brings remarkable benefits to their lives, and that's exactly why it should be available to anyone that wants to use it.

My concern is that AI's (current) environmental footprint is being overlooked by Microsoft in its desperation, and it's pushing the product on to

people that will never use it. If Microsoft announced that Windows 12 will come with a free elephant, there would be an uproar about the upstream costs of feeding the beast and utter dismay at the downstream impact of us all shovelling dung into the street before we can leave the house. Some may find the elephant useful, but most will question why there's an unwanted pachyderm blocking the view to the TV.

Rolling out Copilot to every Windows PC is giving everyone a free elephant. Microsoft has invested billions in an elephant farm and it's haemorrhaging cash paying for feed while subbing the nuclear and fossil fuel industry to claim it's sustainable, despite hordes of ecology experts saying that it isn't.

Behind the smoke and mirrors of AI remains Microsoft's "business as usual" strategy. It can only succeed if it convinces enough people to pay a monthly subscription to adopt an elephant. It's a tough sell.

To return to my customer's question: will Windows 12 be an AI-fuelled, NPU-only, paid-for upgrade? You'd be foolish to bet against it.

LG: Professional repairer #1

Recently I was contacted by a *PC Pro* reader with an enquiry that sent me down a rabbit hole. The request was to fit a replacement laptop battery, which was complicated because the manufacturer was LG. There's nothing wrong with LG laptops, but I can count the number I've had in the shop on one finger. LG doesn't have the market share of HP, Lenovo, Asus or Dell, so getting spares is tough.

The machine was an LG gram featuring a 17in screen and a 10th gen Core i7-1065G7 processor (visit **tinyurl.com/364LGgram** for the exact details). My usual battery suppliers couldn't help, so I hopped to the LG parts site, finding copious spares for dishwashers, tumble dryers and TVs. Nothing for computing. I eventually found LG's (excellent) Right to Repair section and could tap up the machine's model number to discover the battery's part number. Frustratingly, there was no link to purchase.

Also on LG's Right to Repair page is a section called "Repairer Registration". I was able to upload our business registration and liability insurance, which LG requires as proof of being a professional repairer.

If you're new to this column, then you may be unaware that in the UK, there's no official qualification for PC repairers. The only thing that makes me a PC pro is that I am officially registered and fully insured, but I suppose having the genuine honour of writing for the world's greatest PC magazine counts for something, too. I think LG's request for this documentation is sensible and rational.

ABOVE LG laptops are a rarity in the repair shop

ABOVE LEFT Sourcing spare parts isn't easy

There was a short delay before I received a phone call from LG's network operations & technical co-ordinator explaining that it didn't know how to handle my registration. After I asked why, they said: "While the option is available, no independent repairers have applied to be an LG IT approved repairer previously. However, we have suppliers of approved spare parts, including LG Parts and 4LG.co.uk."

After several days, LG eventually sourced a replacement battery for a reasonable price, but to buy it required a call centre to call me, adding friction to the process. The reader has yet to decide if they want to proceed, so I can't yet report if the ordering process will be smooth. LG is clearly playing catch-up in the IT repair-space, which is odd given its experience in selling spares for white goods, but it perfectly demonstrates how much independent repair has been ignored by tech companies.

"Will Windows 12 be an AI-fuelled, NPU-only, paid-for upgrade? You'd be foolish to bet against it"

Lenovo, Dell and even Apple are making it easier to order spare parts because legislation says they must. LG told me: "LG Electronics is committed to manufacturing sustainable products and continues to invest in repair operations to enable consumers to exercise their 'Right to Repair' and extend the lifetime of their LGE product."

I've told LG that when it's properly open for PC spares to let me know, so I hope to bring a positive update to this story in 2025.

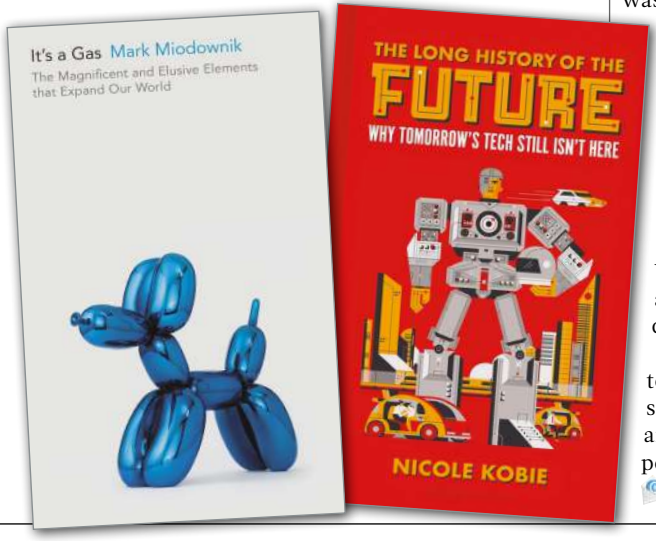
Free prize quiz this way!

It's time for the *PC Pro* Christmas prize quiz. This year I'm giving away two books signed by their authors: *It's a Gas* by Mark Miodownik and *The Long History of the Future* by Nicole Kobie. Both are masterclasses in the craft of methodical research-based storytelling with an expert perspective to both educate and entertain. I'm also reasonably confident that a third book will join the prize pile.

So, listen carefully. Recently a PC came into our shop that restarted when playing intensive games. It wasn't a thermal issue, but a problem with the mouse. To be in with a shout of winning a book, tell me (in no more than ten words) what was the problem with the mouse? Email your answers to lee@pcpro.co.uk. Entries close on 31 December 2024. At least two winners will be pulled in the New Year and allocated a signed book at random. As always, my wife's decision is final.

Finally, it only remains for me to thank you once again for supporting *PC Pro* in 2024. Alison and I wish every one of you a peaceful Christmas and New Year.

lee@inspirationcomputers.com


It's a Gas Mark Miodownik
The Magnificent and Elusive Elements that Expand Our World
THE LONG HISTORY OF THE FUTURE
WHY TOMORROW'S TECH STILL ISN'T HERE
NICOLE KOBIE

BELOW Win a signed copy of these two superb books

ROIS NI THUAMA

"My old mum, who thinks 'cloud' means rain, started worrying about supply chain vulnerabilities"

Move over resilience, there's a new buzzword in town – and if you aren't already taking the supply chain seriously, now is the time to take action

If resilience was the buzzword for the years 2022 to 2024, then get ready, because 2025 is going to be the year of the supply chain. I'm staking my claim early.

Why am I so confident that supply chain management will be at the forefront of everyone's minds? The answer lies partly in the inherent complexity of the notion of resilience. It's a commendable goal, but its definition and implementation can be so varied that extracting tangible value from it often feels more like a philosophical debate with stoned freshers than a practical pursuit with professionals.

There are, in my view, several other reasons why supply chain management is going to move up the ranks, outstripping this nebulous concept. First, it does what is says on the tin. Encapsulated in that phrase is a call to action: manage the supply chain. Second, there are clear benefits of tightening up the supply chain, including cost savings (the supplier picks up the tab) and risk mitigation (the supplier cleans house by addressing known threats), all of which will help businesses.

But the simplest explanation for why the supply chain will become the hottest topic in town is because of the events that unfolded at the end of the summer, bringing this critical issue into sharp focus.

When a concept moves from tech specialists and industry insiders to the public, you know it's significant. My old mum, who thinks "cloud" means rain, started worrying about supply chain vulnerabilities.

More accurately, she wondered whether it might be possible that someone could have interfered with her remote control, causing it to explode. Before you ask, the answer is: yes, she's fine, she's just a news junkie. Like any decent adult offspring reassuring an elderly parent, I asked her if she was using it to communicate with terrorists and plan atrocities; she said no, I said she needn't worry then.

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"There are clear benefits of tightening up the supply chain, including cost savings"

It was in this moment that I knew we had a major "new" topic on our hands. The supply chain issues faced by terrorists hampering their activity were mirrored in many ways in the commercial world. Then to round it off Disney ditched its cloud-based teams communication platform following a breach and it seemed like suddenly the issue of supply chain problems was everywhere.

And honestly, who could blame Disney for tidying up its supply chain? Disney discovered that 1.1TB of confidential messages sent using Slack had been exposed and released by a group called NullBulge, which should be a crime against English, but isn't.

As with all matters like this, context is crucial. To give you an idea, the size of the UK government's total web archive is 379TB, with 1.1TB being roughly 1/344th of that. Yikes! No wonder Disney was upset and reported that it was transitioning away from Slack; that's a lot of confidential messages.

But while the importance of the supply chain is now more widely understood and elevated in communal consciousness, it has been a key consideration for some businesses for quite some time.

Nothing new under the sun

In 2017, a major British bank issued a memo to its suppliers and partners. The document, which I was allowed to review at the time, included an evaluation that outlined the findings of an exercise that had been conducted by the bank.

The bank had performed a comprehensive due diligence assessment of its supply chain. It revealed several deficiencies among its suppliers and partners. The bank communicated in clear, pragmatic terms that it required its suppliers to adhere to specific fundamental requirements, failing which the bank would need to consider alternative options.

The implications were clear. Fix your problems or the bank will disengage and find alternative suppliers and partners.

The memo I read was polite and professional, and it contained a clear instruction. It also outlined clear consequences: failure to conform meant you're off the list. It reminded me of Robert De Niro's portrayal of Al Capone in *The Untouchables*, where he states, "You can get further with a kind word and a gun than you can with just a kind word". The memo seemed to embody both approaches.

Needless to say, the action by suppliers and partners to comply with the bank's reasonable request was swift, conducted at such speed

RIGHT Disney found that over a terabyte of messages sent via Slack had been compromised

that the value and utility of pushing best practice down through supply chains was self-evident. Not only was the bank in a stronger position, but so was each business in its supply chain. I don't imagine it sent thank you cards, but it should have. Of course, not every business can publish such an edict to its suppliers in the expectation of almost 100% adoption, but banks with deep pockets can expect cooperation.

What the brains trust behind this move had achieved was added value in two ways. First, it had set in place measures that would materially benefit the firm's ability to protect itself. It had achieved this swiftly through requiring its suppliers to commit to a course of action to remediate the threats it was facing. Second, it incurred no additional expenses to address these vulnerabilities by transferring the cost to its suppliers. Classic win-win.

For the bank to achieve this, it needed a comprehensive list of its suppliers. If the list was partial or incomplete then the project couldn't succeed. The bank would be blind-sided by vulnerabilities in part of the supply chain it didn't know about. We often learn about departments going rogue and introducing shadow IT – tech that has been adopted by departments without the proper rigour. Marketing, I hear, is like the wild west for spinning up solutions they love and that security folks loathe. Love it or loathe it… what rarely happens in these instances is that this kit is free. So, follow the money.

This is where cross-functional collaboration is essential. Assuming the accounts and contracts teams are preserving the information they need, providing a full list of suppliers should be simple. If it's not and the accounts can't provide you with a comprehensive list of payees, you've bigger issues on your hands.

Quick fix, easy win, ditch BYOD

If a single supplier feels like it could be a lot of trouble, then can you imagine the issues that arise when you pull in multiple tools all at once? This arises on at least two occasions:

- When you permit employees or contractors to use their own device, niftily shortened to BYOD when it really should be BYOD OMG RUJK;

or

- When you acquire a whole company.

Years ago, when BYOD became a thing, my associate Mark Evans was quoted in the press as saying, "BYOD stands less for Bring Your Own Device and more accurately Bring Your Own Disaster". Apart from being somewhat aggrieved that I didn't dream up that gem, it's difficult to disagree with the notion.

On the one hand, businesses exercise extreme caution when it comes to kicking the tyres on vendors and their products. So why on earth would they let someone who has no clue walk into the business with a laptop full of trouble?

It's worse than simply being inconsistent; it's indefensible. Or so I thought until I kicked it around with one of my favourite CISOs who, it must be said, made a compelling case for BYOD. Things have moved on considerably since the days of bring your own disaster.

I learned that his firm had implemented Google Chrome Enterprise as its enterprise browser. Although the firm's 10,000 employees were already using the Chrome browser regularly, the organisation's IT leaders recognised an opportunity to improve its usage.

It enables security controls to be delivered directly to the device via the browser, regardless of location. This can prevent employees from visiting websites with malware or engaging in risky browsing activities.

All of this does rather undermine my case to abandon the policy of allowing employees to BYOD. It does, however, raise the question as to why employees might be interested in handing over their own handset that they paid for to their employer to have additional software installed, but that's an article for another day.

ABOVE BYOD: bring your own disaster?

"Resilience, which is only ever the outcome, has had its moment in the sun"

All in all, what this demonstrates is that mature businesses with a sophisticated posture recognise the importance of strengthening all the links in the chain. However businesses decide to proceed, ensuring that each of these links (tools or vendors) can be scrutinised and reviewed must be prioritised.

Moving to the second issue: acquiring a whole company and a whole network of suppliers. It seems to me that being able to provide the potential buyer with a comprehensive overview of the business's supply chain and a snapshot of their cybersecurity posture has significant commercial value. This utility improves visibility for the buyer and reduces friction for both parties, decreasing the cost of the due diligence and post-integration in the event the business is acquired. Your only question is: where do we sign up?

New priorities

Resilience, which is only ever the outcome, has had its moment in the sun. It tells you precisely nothing of value to do to help business leaders protect their business. Resilience, it's been real, but there's a new priority. One that is less about philosophy and more about pragmatism.

Supply chain management offers a clear, concrete and straightforward way for businesses to help themselves and achieve resilience through tangible measures. Shift the cost to your supplier, start requiring businesses to implement the minimum standards and manage your supply chain.

rois@rtconsulting.ltd

BELOW Chrome Enterprise allows security controls to be delivered via a browser

DAVEY WINDER

“I like to dip into my spam folder when I’m feeling down and need a good fall-on-floor laugh”

Wasps aren’t the only despicable creatures that can sting you – beware the AI-generated Google support guy and SQL injection attacks

I don’t like wasps; even as a multi-decade vegan I consider them the Nazis of the animal kingdom. That said, there’s one kind of wasp that is a friend to all, and that’s OWASP. The Open Worldwide Application Security Project is a security community that produces some of the most helpful documentation and intelligence available for application developers.

One such resource is the OWASP Top 10 (**tinyurl.com/3640wasp**), representing a broad consensus of the most critical security risks that developers of web applications should be aware of. The latest of these lists will become available, fingers crossed, during the first half of 2025. Meanwhile, we are left with the top ten for 2024, which remains highly pertinent. I mention this as sitting in third place on the list of shame is the “injection” category, which includes the dreaded SQL injection common weakness enumeration.

Simply put, an SQL injection attack uses the insertion of a SQL query via input data from client to application. OWASP describes them thus: “SQL commands are injected into data-plane input in order to affect the execution of predefined SQL commands.” You would hope that by now, given the amount of security awareness surrounding what has become “old hat” in vulnerability terms, that SQL injection would be of little consequence to most savvy developers, and as a result application users. It appears, however, that nothing could be further from the truth.

The security boffins at Indusface (**indusface.com**) looked at search data from Google Trends and discovered that UK searches for “what is SQL injection” surged by more than 500% between September and October 2024. That could be for any number of reasons, to be fair, from cybersecurity degree students looking for information through to organisations looking to protect themselves from the threat, with a whole tin of something else in between.

Davey is a journalist and consultant specialising in privacy and security issues
@happygeek

“Why do people have locks on their doors and then leave a window open?”

But sending me that statistic did serve two useful purposes: it spurred me into wondering why SQL injection was still a thing, and it spurred Indusface into providing mitigation advice when it comes to the risks of this exploit methodology.

The why before the how

Let’s think about the why before the how, shall we? Actually, when you think about it, the why isn’t that hard to understand, albeit hard to forgive. Why do people have locks on their doors and then leave a window open? Why do people have strong passwords available to them but use the same weak ones across multiple accounts?

It’s not as easy as casting developers who don’t ensure that database inputs are properly sanitised as being incompetent or lazy. I’ll leave those insults for folk who have never been under-resourced, under unrealistic time pressures or overworked and underqualified. The truth is that while the world may have moved ever onwards towards the database-driven cloud environments of today, that doesn’t mean that development practices and technical debt have moved in lockstep with it.

Never underestimate that technical debt issue. Legacy code is called that for a reason and, as with most legacies, it’s hard to shake off. I mean, we don’t really need to have the DevSecOps conversation in 2024, do we? Things were different a decade ago, and that’s the problem – some businesses are still stuck in the 2010s or even the noughties as far as development practices are concerned. Throw in the small matters of web application complexity and connectivity, and the attack surface is wider than a conman’s smile.

There’s no such thing as perfection in the world of security, just as there’s no denying the truth that defenders need to be lucky all the time while attackers only need to be lucky once.

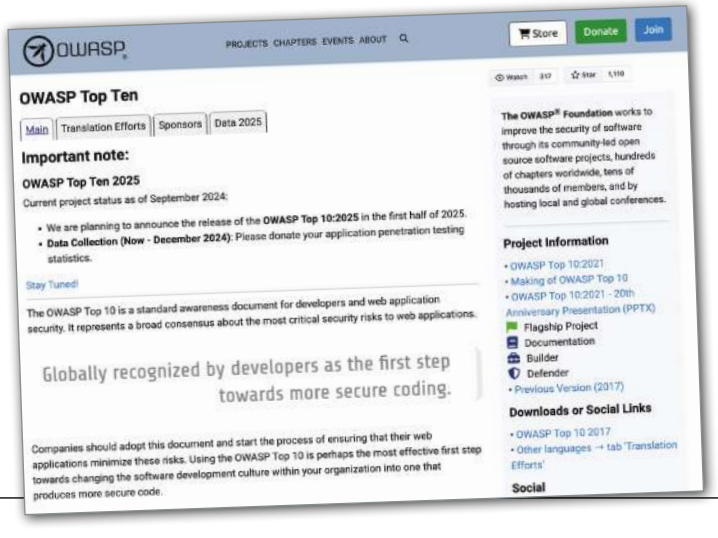
The automation of the vulnerability-scanning process has made this an even more frightening mantra. DevSecOps? Who are you kidding? Developers are not, never have been and never will be security professionals. Working in silos is not something that should be a thing today, but escaping that mentality isn’t as easy as you’d like to think. Developers are under their own individual pressures and security isn’t top of the priority list no matter how many times you or I say it should be. Facts.

Accepting this, like alcoholism, is the first step to recovery.

So now we need to look at how the SQL injection attack surface can be reduced, how to mitigate that threat, how to stop drinking the DevSec Kool Aid. Rather handily, I can refer back to Indusface for help here. I’m not a developer, I’m firmly on the sec side of the equation, and any good security geek will tell you that taking advice from those better positioned to offer it is a key requirement if you want to survive in this business.

All of which is a handy way of saying let me introduce you to the Indusface eight-step SQL injection mitigation plan:

- Implement input validation and proper error handling to secure database interactions.
- Use parameterised queries and prepared statements to prevent malicious SQL input.


OWASP
PROJECTS CHAPTERS EVENTS ABOUT
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OWASP Top Ten
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Sponsors
Data 2025
Important note:
OWASP Top Ten 2025
Current project status as of September 2024:
We are planning to announce the release of the OWASP Top 10:2025 in the first half of 2025.
Data Collection (Now - December 2024): Please donate your application penetration testing statistics.
Stay Tuned!
The OWASP Top 10 is a standard awareness document for developers and web application security. It represents a broad consensus about the most critical security risks to web applications.
Globally recognized by developers as the first step towards more secure coding.
Companies should adopt this document and start the process of ensuring that their web applications minimize these risks. Using the OWASP Top 10 is perhaps the most effective first step towards changing the software development culture within your organization into one that produces more secure code.
The OWASP® Foundation works to improve the security of software through its community-led open source software projects, hundreds of chapters worldwide, tens of thousands of members, and by hosting local and global conferences.
Project Information
OWASP Top 10:2021
Making of OWASP Top 10
OWASP Top 10:2021 - 20th Anniversary Presentation (PPTX)
Flagship Project
Documentation
Builder
Defender
Previous Version (2017)
Downloads or Social Links
OWASP Top 10 2017
Other languages → tab 'Translation Efforts'
Social

BELOW The OWASP top ten for 2024 includes SQL injection at number three

- Maintain applications and databases.
- Monitor application and database interactions and communications.
- Deploy web application firewalls.
- Use stored procedures in the database.
- Regularly patch and update your SQL servers.
- Educate employees and developers on secure coding practices and attack prevention.

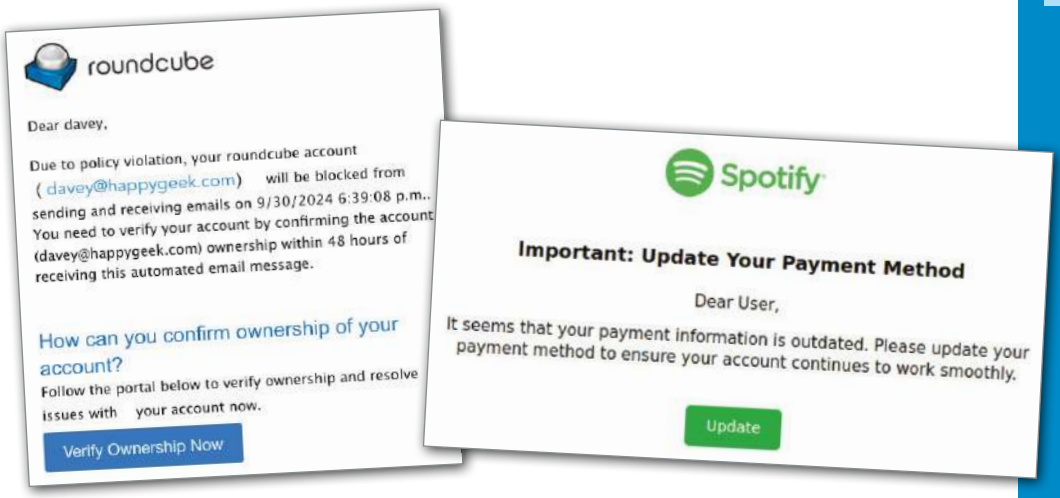
Gone phishing: plus ça change

I don't know about you, but I like to dip into my spam folder when I'm feeling down and need a bloody good fall-on-floor laugh. I mean, seriously, if you thought SQL injection attacks were a leftover from previous decades, then phishing attacks will really blow your mind.

Not all of them, and more of that in a moment, but the vast majority of the stuff that gets caught in my spam trap is truly laughable in its absolute failure even to fool someone who thinks gullible is the most commonly used word in the dictionary. Let me dig out a mere handful of examples that show how many so-called threat actors couldn't perform their way out of a paper bag, let alone socially engineer anyone.

The good old sense of urgency trick is attempted here: verify ownership now, or you'll lose access to your email. In this case, I supposedly had just 48 hours to save my Roundcube email account. The problems here are twofold. First, there's the odd formatting of the message itself. Although scammers have got better, thanks partly to advances in auto-translation using generative AI models, when it comes to grammatical correctness, those formatting gaps loudly suggest some cut-and-paste shenanigans. The other problem is that I don't have a Roundcube account.

Bank emails remain a popular choice of bait in the phishing world, but when as little effort as this has gone into casting the message at me, well, why bother? Apart from the fact that no bank would contact you out of the blue by email "at the request of our customer" who, to add another flag, isn't even named, and nor are there any details of my account or name. Heck, they don't even know if I'm a sir or madam. The formatting is crap once again, the security tips tell you not to open the attachment they want you to open, and – you guessed it – when it comes to having an account with that particular bank...


roundcube
Dear davey,
Due to policy violation, your roundcube account (davey@happygeek.com) will be blocked from sending and receiving emails on 9/30/2024 6:39:08 p.m.. You need to verify your account by confirming the account (davey@happygeek.com) ownership within 48 hours of receiving this automated email message.
How can you confirm ownership of your account?
Follow the portal below to verify ownership and resolve issues with your account now.
Verify Ownership Now
Spotify
Important: Update Your Payment Method
Dear User,
It seems that your payment information is outdated. Please update your payment method to ensure your account continues to work smoothly.
Update

ABOVE **The problem with these two messages? I don't have a Roundcube or a Spotify account**

I'll keep it brief. No, I don't have a Spotify account. 0/10 for effort in personalisation with no name or account number given. Must do better.

The old sextortion attempt, for which I won't try to inject any humour into my dismissal of the attack as these things cause far too much stress for far too many people. However, let's look at the red flags waving madly here. First and foremost, my email client (Proton Mail) has helpfully pointed out that the sender has failed domain authentication requirements and that the email may, therefore, be spoofed. As, indeed, it is. The "elite hacker" is not sending this from my own account, so there's one lie caught.

But the biggest red flag sits in the lie that this hacker is going to send details of your illicit activity to friends, family and colleagues unless you pay them a relatively small amount of money. If they really had full access to my account, they would be using the information within to reset passwords and use that ongoing access for far more rewarding purposes.

"The vast majority of the stuff that gets caught in my spam trap is truly laughable"

BELOW **AI-generated deepfakes are getting cleverer by the day**

Beware the AI-generated Google support guy

Which brings us nicely onto those cybercriminals who do put a bit of effort into their attack campaigns and, as a result, are far more of a threat to even the most well informed of potential victims. People such as the security consultant Sam Mitrovic, who found himself on the sharp end of just such a scam recently (**tinyurl.com/364sam**).

Targeting his Gmail account – and given that Google says there are 2.5 billion active Gmail accounts its users are a common prey – Sam was first in the crosshairs a week before things got really sticky. A Google account reset confirmation notification and a missed call 40 minutes afterwards supposedly from Google support were dismissed as the usual attempts by fraudsters to con their way into grabbing credentials.

Fast-forward a week and another account recovery notification dropped, followed exactly 40 minutes later by a call. This time he answered. The caller, claiming to be from Google support and calling from a number which, when Sam checked, appeared to be from a genuine Google number, spoke with an American accent and referenced the "fact" that the account had been compromised for seven days. No surprise then, that alarm bells rang as Sam recalled the notification and missed call from the week earlier.

Now, it turns out that the phone number that was being used was, kind of, a genuine Google one. A search actually led to Google business pages and details of numbers used when getting calls from Google Assistant. "At the start of the call, you'll hear the reason for the call and that the call is from Google," the genuine support pages confirm. "You can expect the call to come from

Continued from previous page

an automated system or, in some cases, a manual operator."

That would be enough to fool a lot of people a lot of the time, especially if they were already stressed by the possible account compromise under way. "He asks if I'm travelling," Sam wrote. "When I said no, he asks if I logged in from Germany, to which I reply no." More stressers right there.

However, being a security professional, Sam was not ready to be fooled just yet. He asked "support guy" to email him confirmation of what was happening and what needed to be done. Support guy did just that after a bit of typing noise in the background. That email came from what, once again, appeared to be a genuine Google domain. The thing is, email domains are very easily spoofed, and so that this email looked like it came from an account called workspacesupport@google.com is no proof that it actually did.

What sealed the deal, as far as scam recognition goes, is that Sam spotted there was an incorrect domain in the "to" field: googlemail@internalcasetracking.com. At that point Sam knew this was definitely a scam. Digging around a bit later, Sam discovered that the threat actor was spoofing the sender's email address using Salesforce CRM, enabling him to set the sender to anything he wanted to and send it across Gmail/Google servers.

When the conversational silence was broken by support guy saying hello, followed by more silence, and then hello again and again, with both pronunciation and the spaces between being a little too perfect, Sam knew he was "talking" to an AI-generated voice.

The moral of this tale? AI deepfakes aren't just used in highly targeted whale phishing attacks against senior executives these days; the technology has evolved to the point where it's accessible enough and affordable enough to be used in scams such as the one Sam luckily escaped from unharmed.

Be careful out there, folks. Use 2FA on all accounts where possible and don't let knee-jerk reactions win the day.

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STEVE CASSIDY

"You can't create a set of rules and expect them to work forever"

It may be tempting to adopt a scorched-earth approach to buying new hardware for your business, but that won't solve your security problems

2024 marked a turning point in personal computing. For now, I'm going to ignore the corporate and business space, which Intel-based PCs still dominate, and will continue to do so for the next five years or more. The home market is where change is rushing towards us, as so many of the new laptop designs are moving to different processor platforms. It's now possible to conduct all your computing activities without using a CPU made by Intel, or indeed without using the entire architecture that has powered personal computing for the past three decades.

This change is all down to the Microsoft/Qualcomm development deal. It's a partnership that has been in progress for a good few years, with the Surface Pro X its one-time flagship model, but it only really broke surface in 2024 when Qualcomm's much-praised silicon powered a tranche of Windows on Arm devices in the early autumn. This was when Microsoft announced its Copilot+ PCs, along with their need for an NPU that hit 40 TOPS minimum. At the time, this meant Qualcomm's Snapdragon X Elite chips and nothing else.

The deal wasn't due to an isolated case of Redmond having an extended hissy fit with Intel or x86, or a messianic go-it-alone conviction: Microsoft is simply following the industry trend. Apple proved that Arm architecture worked for laptops and PCs by shifting from Intel-only silicon to Arm-only silicon within a couple of years, and delivering stellar battery life – and performance – in the process.

These changes have left Intel in the lurch. With die-hard gamers being obsessed by AMD's Ryzen, and older PCs being at least adequate for individual, non-gaming workloads, Intel has little of the market left as its preferred or exclusive territory. It's even been true of workstations, with AMD's Threadripper and Threadripper Pro series pushing Intel's once-dominant Xeons into second place for sheer performance.

Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart
@stardotpro

"You can't cover your eyes and pretend it isn't happening"

Did you see this coming? I certainly didn't, which is why I'm pulling all the threads together here – particularly for the benefit of harassed IT managers who may not have spotted the tectonic plates shifting below them. And you can't cover your eyes and pretend it isn't happening, as the past few years has also seen a shift to working from home becoming the rule rather than the exception. More work is done on PCs bought for domestic use than ever before.

That means the home computing sector is calling many of the shots that were previously left to IT managers. And this brings us to the next great challenge: staying ahead of the infectors, the scammers and the data thieves. Something that will be easier if you're on a 2025 hardware platform rather than one from 2018. It's the work environment that will start to show the strain of upkeep of older machines, and I'm going to deliver a couple of scenarios for fixing that in unexpected and rapidly achieved ways.

BELOW Microsoft's Copilot+ PCs were initially powered solely by Qualcomm

Silent security

Perhaps the most insidious force driving obsolescence in technology is the wilder extremes of the security business. I expect we're all used to "mute failures", when you thought you pressed Buy It Now or logged in, but your browser does nothing. There are no "upgrade your browser" reminders, no messages accusing you of being a skinflint or an amateur hacker. You just have to figure out, by magic, that the cause of the problem is obsolescence. One day soon, someone won't be able to buy their leading-edge laptop because the seller's e-commerce site invisibly fails to permit their old machine's browser to complete a transaction.

This is a conceit on the part of website security developers. When they deliver the "secure" version of their websites, they believe their browser preferences represent not just a personal preference but the optimal choice. If you have another preset for pop-ups, bad luck; website says no. I'm amazed that the recent and uncomfortable decline of Intel hasn't taught these guys a salutary lesson: like the old Sinatra song says, riding high in April, shot down in May. You can't create a set of rules and expect them to work forever.

One reason security developers are locking down their websites to such a degree is to combat the monstrous quantity of fraudulent and illegitimate transactions flowing around the world. I've read a few papers discussing the options that financial institutions are considering to combat these, and they give an intriguing insight into the developers' perspectives. The papers suggest that the most effective strategy might just be to slow payments down. Would it really be so bad, they say, if your PayPal payments took a week to arrive?

This is one of those drop-your-lunch concepts. While your bacon and avocado bagel is sliding towards the floor, just think about the whole idea of instant actions when applied to payment. This is such an utter fundamental of the entire discipline of information technology that bucking the trend can seem heretical, but grab that bagel before it hits the carpet and consider this objectively.

To take the world's simplest example from another field, consider my email provider. It operates message rejection: every incoming email is marked as "rejected" to the originating SMTP server, and it is invited to resend. 99% of the world's spammers don't honour the resend request message, which leaves my provider's other security layers to deal with the higher IQ spams. Strictly speaking, this isn't a technical fix, and it definitely isn't AI.

Now let's head back to the financial world. A proposal to insert a half-week delay in the handling of online payments has been met with shrieks of derision, to put it mildly. But what, exactly, would be so wrong about this type of measure? Us older folk remember how payments used to work when everybody used a cheque book. As I've mentioned before in these pages, I even had an office with a ringside seat on the process, because it took place in the building next door. Squadrons of young women in high heels, marching around carrying trays of cheques – by modern standards, an immensely expensive, time-consuming and labour-intensive process.

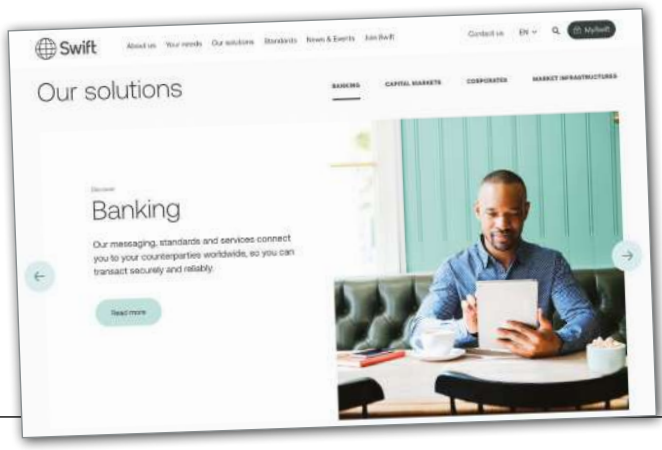
This wasn't merely a means of keeping tray-carriers in a job. It provided a long enough pause for dubious money movements to be investigated (mostly via Telex message, in those days) and, if they were found to be unusual, put on hold and followed up. You can't do that now, despite all the world's computing horsepower. We move money so quickly that it's given rise to a massive increase in what's known as carousel fraud, where stolen money gets semi-automatically pushed from one account repository to another. So quickly, in fact, that the forensic trail of transfers defeats the victim's efforts to get it back – not least because misinterpreted regulations about individual privacy mean that even two hops through bank accounts mean that the victim can't approach the recipient bank because no identifiable part of the transaction includes them as a participant.

ABOVE **The financial system was much safer when we relied on the gold standard**

"Would it really be so bad if your PayPal payments took a week to arrive?"

Fixing these issues isn't a matter of fiddling with code in e-commerce servers. It's also not about blockchain, which protects transactions at the cost of consuming vast amounts of electricity just to exist, never mind being used. The most likely source of enhanced protection are the various regulators, who are well placed to come out with some "thou shalt" style requirements, of which the proposed built-in delay is only one example. While they're at it, more consumer rights regulation would also be welcome when it comes to those awful zero error message failures.

If you want to see what's actually happening, to get an insight into the battle between non-updated browsers and devs who think they know best, then the first place to look is in the log files on your machine. Most useful for this, I think, is the Apple console window. Apple computers look serene and designer cool on the surface, but opening their old-school console window will reveal a storm of messages. Not all of them are red alert errors, but if anything is said by any code module on your machine, it will flash past in the console window.


Swift
Our solutions
Banking
Our messaging, standards and services connect you to your counterparties worldwide, so you can transact securely and reliably.

BELOW **Slowing down bank payments could help prevent fraud**

Removing the old fossils

The biggest difficulty of being an IT management person is explaining why you can't just upgrade stuff. "Everybody else" is a phrase you come to dread, because "everybody else" could be in a completely different situation from yours. Perhaps the most challenging person is your boss, who wants to be able to hold his head high – or her head high, let's spread this cliché across the sexes – down at

the golf course, and never be accused of being the cause or source of a widespread infection. After all, a new PC is a secure PC, right?

Evidence of infected machines in corporate deployments isn't hard to come by. Consider one remarkably irritating experience I've had in the past month. A certain yellow-liveried international courier company had an unusually slow delivery for me, because it was expensive enough that there was duty to be paid. In the middle of the exchange of emails that made the payment, I was hit with carefully crafted phishing emails. The type that encourage you to "click here" to access the payment portal, but which on examination don't come from any domains owned by the alleged sender, nor present any links affiliated to the business.

On this occasion, when I backtracked the trail of forwarding SMTP servers handling the thing, I came across an Indian construction firm that looked great on the surface, but turned out to have collapsed during the pandemic. Just for laughs I sent the now defunct company an abuse report, in return for which I got a spam email advertising its services. Naturally the links in that email were as fake and infectious as the ones in the original phishing mail.

I know, there will be many who immediately say, "How do you know you're not the one who is infected, Steve?" In this case, the scenario is pretty simple. I don't get phishing emails for any other deliveries or outstanding payments from any other fake couriers, much less just at the right instant to fit into the flow of information and appear legitimate. I am forced to the conclusion that the traffic patterns of these naughty emails show that the yellow courier company will not, or cannot, maintain a decently secure IT platform.

Why is this? It operates in over 200 countries, employs tens of thousands of developers and hundreds of thousands of staff. Surely deployment resources such as those should make the problem just go away, no matter what it is?

Well no, not really. There are two absolutely vital technologies you must both understand and use, which crush the whole "obsolete is vulnerable" idea at a stroke. The resources in over-supply within vast enterprises are not of the right type to address this problem, because when taken in isolation neither can address the issues.

I'm thinking of zero trust network architectures on the one hand and desktop virtualisation on the other. Put your ancient and potentially infectious business software app within a complete and compatible VM desktop environment, and then set it up with a separate IP address and subnet from its host workstation. So far, so straightforward – with the possible exception of not being able to use DHCP for the guest machine's IP address setup. That's because the harder part of the configuration is having network switches that work with client machines present on more than one subnet.

That's a slight oversimplification of what a zero trust network must do to isolate all your client machines from one another, but the basic truth of the matter is that traffic from host and guest VMs is segregated even when it flows down the same physical lumps of wiring. Packets from the DHCP-supplied subnet don't confer the ability to break "across" into any others – they're just not read by the network chipset in either the smart switch or the correspondent PC. That thing where a well-configured broadband connection doesn't let you snoop on a neighbour's traffic? Just like that.

So, why doesn't this approach work out there in the wild? The answer is depressingly non-technical: fiefdoms. The desktop people are frequently outsourced, and adopt a simple scorched-earth approach to diagnosis or infection management. Far cheaper to just bin the infected machine and roll in a new one than to actually report back on what got loose and who it hurt.

This is not the problem-solving approach of a zero trust architectural guru. Zero trust tries to do what it says on the tin: write a bunch of filters that treat internal machines as just as untrustworthy as external ones. Discarding suspect PCs without the benefit of forensic follow-up is completely anathematic to a zero-trust person.

I like ZT plus virtualisation as a fix for the obligation to retain insecure and obsolete machinery, because it's made up of a lot of technologies you can see working already. Other solutions come with well-hidden and frequently astronomical price tags. If you have the latitude of action with your employers to take a step back and view the likely outcomes of a sudden turnover in home and client machines, then now is the time to decide whether zero trust ought not to be left as an ivory tower technology, when combined with a rational approach to virtualisation.

And while you're at it, this might be an excellent time to investigate the Arm-powered laptops that are starting to appear. Change is coming, and it's better to be ahead of it than lagging behind.

cassidy@well.com

ABOVE **Evidence of infected machines in corporate settings isn't hard to come by**

"Now is the time to decide whether zero trust ought not to be left as an ivory tower technology"

BELOW **A parcel that required payment of customs charges led to a phishing attempt**

Sony PlayStation: the game changer

David Crookes looks at how the first PlayStation turned the gaming world on its head, impacting rival console manufacturers, videogame developers and the perception of games themselves

ABOVE **Sony's 1994 PlayStation with the iconic control pad**

In December 1994, it was becoming clear where gaming was heading: straight down the road to the third dimension. Although 3D games had been around for a while – DOS titles *Wolfenstein 3D* and *Doom* being the most notable – one play of *Ridge Racer* was all it took to convince larger numbers of gamers that 3D was the future.

Ridge Racer was a launch title for Sony's PlayStation, a console that had made its debut in Japan. As history will attest, this machine forever changed the course of the videogame industry by successfully smashing the long-held Nintendo-Sega duopoly. It drove forward with fresh thinking and a determination to turn the industry on its head. In short, the PlayStation was a game changer.

It could have been so different. Six years earlier, Sony had no desire to become a major player in the console market. Instead, it partnered with Nintendo to create a CD-ROM add-on device for Nintendo's 16-bit SNES called the Play Station (with a space between the words).

Yet when Sony announced the partnership during the 1991 Consumer Electronics Show in Las Vegas, Nintendo poured cold water on the deal. It said it had signed a separate arrangement with Philips for a CD-i add-on, and it was later confirmed that the Sony-Nintendo project was off. Understandably annoyed, Sony decided to go it alone with a product that would eventually go head to head with its former partner. The desire for revenge appeared strong.

Ken Kutaragi, who had worked his way up at Sony having started in the company's digital research labs, was tasked with heading the new console project, and the resulting PlayStation emerged with some very impressive stats.

The new console had a 32-bit R3000A processor clocked at just over 33MHz. It could also offer 2MB of RAM and 1MB VRAM, plus 16-bit, 24-channel sound and the ability to play audio CDs. But the PlayStation became much more than a list of technical specifications.

"Sony decided to go it alone with a product that would go head to head with Nintendo. The desire for revenge appeared strong"

Gaming grows up

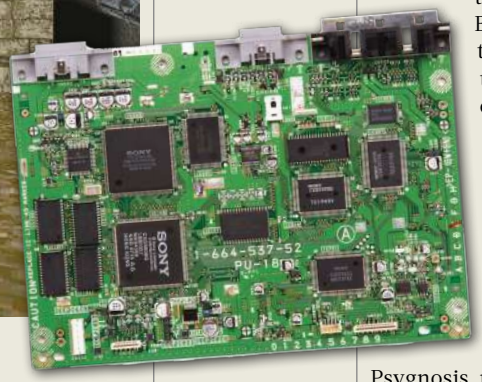
As it happens, by the time Sony released its console, Nintendo wasn't its main concern. The latter was still selling the 16-bit SNES and its own next-gen machine wouldn't arrive for another couple of years.

Instead, the PlayStation was competing against the Sega Saturn, the successor to the popular Mega Drive console. But while the Saturn got a month's head start on Sony and offered exclusive titles such as *Sonic the Hedgehog*, the Sony PlayStation ultimately ended up running rings around it.

One of Sony's big decisions was to go all in with a console that played 3D

LEFT **FMV, intros and cutscenes became a staple of many PS games. *Tekken II* is etched into many a memory**

LEFT *Tomb Raider* made its debut on the Sega Saturn but was best known as a PlayStation title



ABOVE The console motherboard included a 32-bit R3000A processor clocked at 33MHz

games, and the machine was fast enough to render 360,000 polygons per second. This was in contrast to the Sega Saturn's video chip, which was built with 2D sprites in mind. This gave the impression that Sega still had one eye on the past while Sony's view was on the future.

To ensure the experience could match expectations, Sony knew it needed to get top developers on board who were capable of making the most of the technology. It needed to spread the message that this was a console like no other – a consumer device rather than a toy. As part of this strategy, it insisted that every game developer had to banish 2D in favour of 3D.

Sony wanted the console to open up gaming to a mainstream audience, and to transform a largely niche hobby into something cool. And it wanted that to happen wherever the console launched, whether that was in Japan (December 1994), Europe and North America (September 1995) or Australia (November 1995).

To that end, a demo disc contained a giant, walking 3D T-rex that quickly caught people's imagination and became iconic. The aforementioned *Ridge Racer* game was almost indistinguishable from the blistering, chunky-car coin-op arcade original and it, too, served to impress.

Over time, more and more standout games were released including *Metal Gear Solid*, *Castlevania: Symphony of the Night*, *Resident Evil*, *Tekken*, *Crash Bandicoot*, *Gran Turismo* and *Silent Hill*. Some games carried 18-certificate ratings and the message was clear. Gaming was growing up.

In double-quick time, on the back of a series of whip smart marketing campaigns that got people talking (one suggested the power of the PlayStation would corrupt players and turn them into a monkey), gaming came out of the bedroom and began to take pride of place in the living room.

The PlayStation also ended up in bars and nightclubs, primarily on the back of a game by top UK development studio Psygnosis called *WipEout*, the soundtrack of which featured the Chemical Brothers, Orbital and Leftfield. The capital "E" was deliberately stylised as a nod to ecstasy and it further highlighted Sony's targeting of an older, more influential demographic.

"Games like *WipEout* helped get the message out that PlayStation was a game-changer and it was cool to be a young adult who enjoyed playing games," said the game's designer Nick Burcombe. "Rolling the PlayStation out into nightclubs such as Cream was clearly aimed at changing this perception and, as we can see today, it worked."

With great power

"The business model changed dramatically because of the transition from cartridge to CD," said Ray Maguire, the former managing director of Sony Computer Entertainment UK. "The cartridge model required a commitment in terms of units ordered and payment was back-to-back letters of credit. Delivery would also run into weeks because production was in Japan.

"All of this meant you had to get the forecast right to maximise profit. Too small a forecast, and you'd risk running out – the delay in getting more stock could mean the consumers might buy other games instead. Too large, and you'd have to discount the games to clear, writing the remaining stock down. CD production could be turned around within days rather than months. Retailers loved this 'just in time' model for PlayStation games."

The move to CDs also meant that games could be bigger and more detailed because their capacity was far larger than cartridges. Because of the lower cost of CDs, some titles could span as many as five discs. "It gave developers the ability to create bigger and better games," Maguire said. "Simply put, the more pixels you use, the more detail you get. Better definition opened up the options for developers to create games that couldn't be made before."

To encourage developers to climb aboard, Sony assisted with a range of tools and documentation, and it provided development kits well ahead of the console's intended release. Sony bought Psygnosis, previously known for making *Lemmings* and *Shadow of the Beast*, and the studio suggested working with SN Systems to create an inexpensive development system that would run on PCs with two extension boards attached.

This opened up the scope of development and, as David Darling, former boss of Codemasters and now CEO of Kwalee, told us, Sony proved to be very accepting of new studios right from the start. "Sony was much more welcoming as a platform holder than others that had come previously," he said. "They welcomed developers like us with open arms – Phil Harrison and the other guys really helped coach us and gave us all the development tools that we needed."

"In double-quick time, gaming came out of the bedroom and began to take pride of place in the living room"

Harrison had joined Sony Computer Entertainment Europe as executive vice-president for development in 1992, and he became vice president of third-party relations and research and development for Sony Computer Entertainment America from 1996. He would visit development studios to present the PlayStation, explaining what it could do and the type of games that he felt would be desirable and work well.

"I think one thing people forget about the launch of PlayStation was Phil's role," said video game designer David Perry, founder of Shiny Entertainment. "Sony had a 'front man', someone who went out to sell the product, and he did it well. I remember him visiting our offices in Laguna Beach and showing us the famous dinosaur demo. We were all amazed, thinking, 'Wow! Are we really going to be able to do that?'"

BELOW *Fade to Black* used fully textured 3D graphics

Levelling up

This approach was very different to how Sony's rivals approached development. "It

[Sony] had its own dedicated dev conferences, attended by hundreds of developers and we all had great account managers and technical staff on hand to help with any difficulties," said Andrew Oliver, former CTO of Blitz Games Studios

"With Nintendo, you were either in their Dream Team or you were an outsider, and that made it a lot harder to develop for its consoles. Sega was in between. It had the aspirations to be as welcoming as PlayStation but never had the budget and PlayStation was taking all the great staff.

"Sony's goal was to help every developer make the best games possible and, while Sony itself had decided to actively capture an older demographic, it had bought *Crash Bandicoot* and *Spyro the Dragon* to compete with *Mario* and *Sonic*. It gave huge budgets to these studios to make much more mature games as well."

Despite all this, there was still much pain being felt in the industry. "A lot of devs struggled to move from 2D to 3D," said Philip Oliver, former CEO of Blitz Games Studios, which released ten games for the debut PlayStation.

It was a case of adapt or die and, for large numbers of game developers who had spent careers creating two-dimensional games for 8-bit and 16-bit computers and consoles, it wasn't a case of being overawed by the technology but overwhelmed. Some simply lacked the required skills yet found themselves in an industry insisting on it.

"It was new to most of us back in 1994 and it took some learning to adapt," said Andrew Oliver. "Not only did the programmers need to learn new techniques and write new engines, artists needed to change their workflow completely.

"This was a time when they were all happy with DPaint 3 on the Amiga and early Photoshop. Now they had the complex tool of 3D Studio Max, and many struggled with the entirely different type of art required.

"Not only that, we had to get these 3D creations out of that package into our own, newly created 3D engines. It was a challenge yet a challenge we just went for. But there were some studios that were founded on their successful 2D titles and they struggled to get those games on to this new and popular console."

Some difficult decisions had to be made as a consequence. As impressed as Perry had been, for example, it was clear that developing games for PlayStation was a far cry from the early bedroom-coding days of the industry. "My studio was drawing games like *Earthworm Jim* with pencils, and moving to 3D meant we needed new computers, new software and a lot of retraining," he said. "I was so concerned about the transition that I ended up selling Shiny to Interplay."

Under the deal, Shiny could continue to create games under the same management and identity. "Luckily, we had people like Andy Astor (who is sadly no longer with us) and Martin Brownlow, who dove into 3D development with full commitment. Thanks to them, we started creating games like *MDK* in 3D, and we successfully made the transition but, looking back, I regretted selling Shiny. PlayStation showed us that 3D was the future, and thankfully, we took it seriously."

Number crunching

Certainly, developing for the PlayStation appeared to be a safer bet than creating for other systems due to sheer numbers. Another rival system, the 3DO – a console manufactured by Panasonic, Sanyo, GoldStar, Samsung and Creative Technology – sold fewer than two million units. The Saturn shifted 9.26 million and the Nintendo 64 sold 34 million. The debut PlayStation went on to sell 102 million.

And those gamers loved to buy games. *Gran Turismo* alone sold 70 million copies, with *Crash Bandicoot* and *Tomb Raider* not far behind on 50 million and 42 million respectively. Or perhaps you remember *Silent Hill* (8.5 million) and *PaRappa the Rapper* (2.2 million). Developers released more than 4,000 PlayStation games, with cumulative sales of 962 million. And what is perhaps just as remarkable, Future Publishing's *Official UK PlayStation Magazine* reached a circulation of 453,571 thanks, in part, to its monthly cover discs packed with game demos.

The release of the Net Yaroze dev kit in 1997 marked another big landmark. By this time, Sony had relaxed its 3D rule, and this, together with the dev kit, made it easier for one-man bands and small teams to create standout games such as *Blitter Boy: Operation Monster Hall* and *Haunted Maze*. The kit even helped some devs get a start in the industry: Mitsuru Kamiyama created *Terra Incognita*, went on to work for Square Enix and now has 17 games to his name.

"Sony's branding was cool, the PlayStation was powerful, the business model was better and the timing was right"

Never underestimated

Over the years, the PlayStation brand became ever stronger. It saw off Sega which, despite developing the Dreamcast, pulled out of the console market long ago. It also caused Nintendo to struggle for a while – neither the Nintendo 64 nor the GameCube could match the PlayStation for sales, and it wasn't until the Wii launched in 2006 that it found its mojo again.

By that time, the PlayStation 2 had chalked up 155 million sales to make it the best-selling games console of all time. And while the PlayStation 3 drew with Microsoft's Xbox 360 in that particular console war, since the launch of the PlayStation 4, Sony has rarely looked back. Its current machine – PlayStation 5 – is outselling Microsoft's Xbox Series X/S by two to one.

"Sony's branding was cool, the PlayStation was powerful, the business model was better and the timing was right," said Burcombe. "All of these things made it successful. Sony is a great brand name in electronics and it jumped into the games business, disrupted it and succeeded in much the same way that Apple jumped into the portable music business and took over. It was amazing to be a part of that era." ●

BELOW *Ridge Racer*: chunky visuals and slick, arcade-like action

BOTTOM Kick. Punch. It's All in the Mind. *PaRappa the Rapper* was one of the quirkier titles for the machine

Futures

We explore the trends and technologies that are set to shape the future

Are delivery drones finally ready for take-off?

More than a decade in the making, Amazon is again set to run a trial of its delivery drone in the UK. But there are better uses for delivery drones, explains Nicole Kobie

Click. A customer places their order and, at a warehouse miles away, a Fire stick and bag of popcorn is boxed up and placed inside a drone. Quietly lifting off into the sky, the drone zips its way over the Cambridgeshire landscape, delivering the parcel on the customer's lawn exactly 13 minutes later.

This was the future of Amazon deliveries – back in 2016. Little progress has been made on commercial drone deliveries in the UK in the intervening years, but Amazon is now set for another go on (above?) British soil? And it's at least partially thanks to the Civil Aviation Authority (CAA), which is enabling delivery drones to fly beyond the line of sight, escaping the watchful eye of grounded pilots for the first time.

To be clear, delivery drones are in UK skies already. They've been trialled for NHS deliveries to remote locations including the Isle of Mull (*see issue 315, p126*), while BT uses the technology for maintenance and extending coverage in difficult areas, rolling out cables by flying them over obstacles with drones (*see issue 354, p126*).

However, those medical supply trips are line-of-sight flights that largely repeat the same trip over and over, making deliveries from the mainland to an island outpost, for example. That's far easier to regulate than automated drones taking different routes each time. And the use cases are serious, such as ensuring medical supplies or test results can reach hospitals.

Recently, such flights have gone beyond line of sight. In Northumbria, blood samples were delivered between hospitals using Apian drones, while a similar trial with Apian and Wing is running in London between Guy's and St Thomas' hospitals to avoid blood samples getting stuck in traffic.

Such serious trials may suggest the technology – the drones and the systems for flying them – is finally catching up with the hype, and regulators are readying themselves to certify the idea. But for the time being, here in the UK commercial drone deliveries continue to loom over the horizon rather than whirr over our heads.

Amazon optimism

Amazon's hype has flown sky-high when it comes to delivery drones. In 2013, unveiling the idea for the first time, founder Jeff Bezos was confident drone deliveries would happen within four or five years. "It will work, and it will happen, and it's going to be a lot of fun," Bezos said on *60 Minutes* announcing the delivery plans.

"For the time being, here in the UK commercial drone deliveries continue to loom over the horizon rather than whirr over our heads"

A handful of trials took place in the US and Canada, but it was another three years before Amazon's Cambridgeshire flight. Despite a wider trial in the area and a dedicated local lab, the plans foundered.

Perhaps unsurprisingly, given that they're flying things filling the skies above our heads, drones have been

ABOVE **Amazon has been trialling drones for years, but they're yet to truly deliver**

LEFT **Extensive testing means drones can now cope with wind and rain**

slow to take off anywhere. Amazon was operating the drones in the small towns of College Station, Texas, and Lockeford, California. At the end of 2023, the retail giant pledged that airborne deliveries would begin in the UK and Italy by the end of 2024. "The new locations add to our existing drone delivery operations in the US, where we've been using drones to safely deliver packages weighing up to five pounds (approximately 2.2kg) in one hour or less, for almost a year," the company said at the time.

Instead, Amazon shut its Lockeford service. A further site was announced in Phoenix, Arizona, to begin flights in 2024, but operations had yet to start at the time of writing. That drone delivery deadline appears unlikely to be met in this country, though the CAA trial means Amazon may at least get to send its drone up in UK skies again. Asked by *PC Pro* for details of any planned trials, Amazon effectively told us to watch this (air)space.

But don't count out your Amazon delivery driver yet: the CAA trial – as we'll soon see – suggests beyond-line-of-sight tests will take place over many years. And though Amazon's current drone, the MK30, is an improvement over previous models, as it can fly twice as far as earlier iterations and can now finally fly in light rain and some wind. Someone probably needs to tell Jeff that it will have to do better than that to handle the British weather.

CAA flight plans

Two years ago, the government laid out plans to help support the advent of commercial drones in the UK, predicting that by 2030 they would be commonplace. Of course, we've had a few governments since then. More recently, and perhaps more pertinently, the CAA has set up a sequence of trials that could lead to delivery drones. Those aren't the only focus of the regulator's efforts, either.

First, a few definitions. Being a regulator, the CAA uses jargon-filled acronyms rather than terms such as "delivery drones". Instead, the trials are for UAS BVLOS – which sure does roll off the tongue. That stands for unmanned aircraft systems (UAS) and beyond visual line of sight (BVLOS), which means a drone that is flown using its own autonomous vision systems rather than piloted from the ground. Rather wonderfully, the CAA takes care to note it prefers the term uncrewed rather than unmanned, as the former is gender neutral – good to know it's not just men who won't be flying these machines.

Dr Paul Cureton, senior lecturer in design at Lancaster University, and Dr Anna Jackman, lecturer in human geography at the University of Reading, work together on drone research and shared their expertise with *PC Pro* via a joint email. They noted that "the growing deployment and normalisation of larger-scale and BVLOS drone operations in UK skies requires complex and multi-stakeholder attention to airspace safety and risk mitigation, communication and consultation with UK publics, and reflection on the different ways drones impact... resident populations, built environments, natural environments and wildlife."

There's a lot to do, in other words. The CAA's BVLOS Challenge will run six trials to explore the technology beginning imminently, while the more recent technical strategy delivery model offers a roadmap regarding airworthiness, cyber risks and environmental risks.

Technical readiness

Are drones ready to fly? "The technology is not ready," said Antonios Tsourdos, head of the Centre for Autonomous and Cyber-Physical Systems at Cranfield University. "But it is maturing fast."

Of course, drones are only one side of the equation: for commercial deliveries, we'll need infrastructure, too. That, Tsourdos notes, includes everything from navigation systems to permission where to operate, as well as communication networks – mobile signals aren't guaranteed, so how can drones check in when necessary?

"While much focus is also afforded to the technical elements of the how of BVLOS, further attention is also needed to its potential impacts on and implications for built environments and planning," Cureton and Jackman added. "Drones can require the introduction of new infrastructure, or increased amounts of existing infrastructure – [such as] masts – which pose both public response and planning questions and challenges."

"Drones are only one side of the equation: for commercial deliveries, we'll need infrastructure, too"

Indeed, they note, local councils will face a host of planning questions, much as they do when approving a new housing development. "It's also crucial to consider planning issues around the routing and footprint of BVLOS drones (where will they fly, with what frequency, where will they land and on what land?) as such flights will have localised impacts and effects," the researchers said.

One attempt to consider where drones should be allowed to fly is Project Skyway, which sees a consortium of companies including BT working with Altitude Angel to build 265km of "drone superhighways" to build delivery routes between major cities. This makes use of a network of

ground-based sensors, including radio and cameras to watch drones and ensure they aren't interfering with other aerial traffic. The aim is to enable drones' safe travel from one destination to another with their payload, without each drone needing to be overloaded with sensors and detecting equipment.

While that could help link up cities for drone deliveries, the CAA Roadmap is focused on more rural areas, and Cureton and Jackman note that urban environments need to be considered as well. Tsourdos explains that the last mile is the real problem in cities. "If you're living in London, for example, and you're living in a flat, how will it be delivered there?" he asked. "If you're living in a suburb that has a big garden, then problem solved – it's not easily done, but there is an answer there."

For example, you can land in the front garden or put a box or landing pad outside for the drone to target. But in high density urban areas, that's not an option. Indeed, it's notable that most of the existing drone delivery systems are in rural areas, small towns or suburban neighbourhoods. Of course, it's a solvable problem – drones could drop at a delivery point that's close to where you live, such as a delivery locker – but it's one more hurdle to add to the many already slowing down this technology.

But, note Cureton and Jackman, there's more to commercial drone deliveries than technology and infrastructure. The rest of us should also have a say.

Do we want drone deliveries?

Cureton and Jackman point out that the trials and development work must also include efforts to understand public perception of drones. Research reveals there's public support for drones, but they sit alongside concerns around privacy, safety, and visual and noise disruption. A survey by the University of Birmingham and UK Research and Innovation Future Flight Challenge revealed that the strongest backing was assisting emergency services and giving access to isolated communities.

"Our own ongoing research into BVLOS drones also demonstrates the importance of including a range of stakeholders, such as local authorities, into such discussions – given the potentially significant implications of drones upon the built environment and planning," the researchers noted.

Indeed, these aren't typical problems with simple solutions: they require consultation and careful consideration by the public, government, industry, regulators and even wildlife organisations. "While the CAA Roadmap outlines a clear vision to BVLOS, we think both the approaches and their potential impacts need further and careful discussion," Cureton and Jackman added.

And, as Tsourdos notes, although flying parcels above our heads may help dodge and even relieve traffic, they are at best only part of the solution. "If you want to improve the quality of life in cities, it will not be drones that are the answer to your problem," he said, later adding: "It is not the answer to all of our traffic problems."

He suggests drones can help offer a taste of urban life – such as access to restaurant deliveries – to those living in villages or suburban areas, while also cutting costs for postal deliveries. "The population [in the countryside] is declining, post offices are closing, and we need services if you want people to still live there," he said. "They can still have the quality of life they would like, the services they would like, and drone delivery can offer a part of the solution without congestion and no pollution."

TOP Today's drones are line-of-sight flights that mainly repeat the same trip

ABOVE Sensors are used to prevent accidents in the air

That's reflected in the Birmingham survey: respondents were more likely to see drone deliveries as beneficial in remote areas than urban locations.

In short, although we have drone deliveries for the NHS and other serious use cases, expanding it more widely to commercial deliveries has been delayed for good reason – there's simply a lot to consider, and plenty of technology that still needs development, testing and approval. Amazon may keep promising the imminent arrival of Prime Air drones in British skies, but don't expect the sky to be filled with whirring parcels any time soon.

"Drone deliveries aren't a failure – they're just being used carefully, where they offer real benefit"

While that may be disappointing to those in rural locations relishing the idea of 13-minute deliveries, in the meantime we've got faster test results despite London traffic, not to mention the very real benefit of medical deliveries between the mainland and remote islands. Drone deliveries aren't a failure – they're just being used carefully, where they offer real benefit. As much as we'd like popcorn on demand, this is a better way forward. ●

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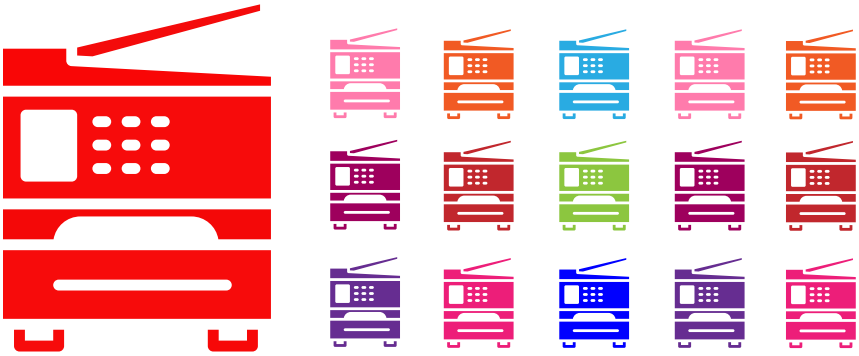
Printers

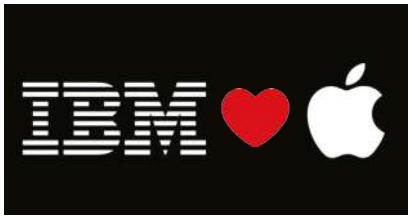
Whether you're looking for an inkjet or a laser, have £80 to spend or £400, our group test of 14 printers next month will hold the answer.



Retro

When IBM loved Apple

If you remember when IBM joined forces with Apple to create an operating system that would reign supreme, you might be curious to know what happened next...



The Network

Upgrade to Wi-Fi 7

We review four business-class Wi-Fi 7 access points and explain what to look for when investing in this cutting-edge technology for business use.

Futures

What are AI agents?

They will supposedly help you get your work done more quickly, and to a higher standard, but how will these miracle agents actually work?

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When travelling, there's one item that Jon Honeyball never leaves behind

It was one of those three-pints-down discussions, when one of my friends turned and asked: "What's your most prized and useful piece of kit?"

Sounds simple, but this is difficult to answer after one pint let alone three. Do you choose a random bit of hardware that you turn to on an almost daily basis? Or that bag of plug adapters and cables you hang onto just in case you need to charge your phone in some random car or airport lounge? Although I try to avoid plugging anything USB into an unknown source; who knows what evil handshaking might be going on down the cable?

For some of my friends, it was their "go-everywhere" computing device. Phones were disallowed, because everyone has one. So the voting included a Surface Pro laptop, an iPad Pro and obvious contenders such as noise-cancelling headphones.

You won't be surprised to hear that I decided to go left-field. I could have chosen any of the above, and depending on the trip, they would have been with me. But there's one item that travels everywhere with me, whether it's thrown in the back of a car or taken on a long-haul flight to the other side of the planet.

That something is my Peli 1510 Laptop Overnight Case.

It's just the right size to hold everything I need for a short trip, even for a day or so away if I pack carefully. There are pouches for power and cables. A 14in laptop is no problem, but it can cope with a 16in chassis at a squeeze. In the main body, I can choose between a simple zip-lidded unit into which anything can be thrown, including clothes. Or go for the full "make any shape you want" in the foam padding, with TrekPak inserts that are ideal for a camera and multiple lenses. The inserts can be changed in a matter of a few seconds between empty, inserts and full foam sections.

It's just the right size for a flight, too. The precise dimensions are 559 x 351 x 229mm, a little under British Airways' maximum of 560 x 450 x 250mm. So it's usually not a problem to take onboard with me.

To say the Peli 1510 is built like a brick outhouse would do a disservice to such structures. I can sit on it. I could probably stand on it, too. The handle is extremely robust, with none of that nasty clicking tubular handle extension nonsense that others use. The wheels have no issues with rough terrain, either. And it's waterproof, dustproof (IP67) and drop-proof, with the reassurance of a lifetime warranty.

It weighs 6.6kg empty, so it's no lightweight carrier bag, but that's still well within the cabin bag allowance on most airlines. If they really insist, I keep a small padlock in for the unlikely event that it has to be hauled into the hold for the flight. Did I mention I keep an AirTag in there, too, which is very useful for reminding yourself where it is, and confirming that it has actually arrived at your destination?

It is, therefore, the very definition of a reliable piece of kit that goes with me everywhere, and has done for over a decade.

There are downsides, of course. First, the static weight is a little high, but the robustness makes up for all of that. And it has a certain militaryesque air that might be offputting in a more artistic environment.

Then there's the price. It costs around 500 notes, depending on where you buy it. Which I accept is quite a lot of money, but I look at it as one pound a week over the lifespan I have enjoyed so far with this case.

Plaster it with appropriate stickers, in keeping with hotel-checked baggage and conference materials, and it takes on a certain menacing air that shows you mean business. And I defy anyone not to be impressed by the loud clunk the latches make when you close the lid.

I can tell you're tempted, so what colour would sir or madam like? It's available in "don't screw with me" black, desert tan if you want a military vibe, silver for the drab minded, plus orange and yellow for those who like the extra attention. And a rather shocking pink if you want to make a different sort of statement.

> "To say the Peli 1510 is built like a brick outhouse would do a disservice to such structures. I can sit on it. I could probably stand on it, too"

I can't see myself needing to buy another Peli Overnight Case in my lifetime, because mine hasn't a serious mark on it, but running through those colours has tempted me. I've already bought various smaller Peli cases in yellow, such as the 1120 case for storing all the bits I need for Wi-Fi analysis (Wi-Spy DBx, Oscium spectrum analyser, various high-end USB Wi-Fi adapters), so if I did buy another, I would probably go for yellow.

Actually, let's be bold and go pink. After all, it would be very easy to spot in the Heathrow baggage reclaim hall.

Jon Honeyball is a contributing editor and has written for *PC Pro* since issue one. He's aware there are cheaper alternatives to the case, but then it wouldn't be a Peli, would it? Email jon@jonhoneyball.com.

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